SECOND SCANDINAVIAN SYMPOSIUM ON RESEARCH METHODS IN SCIENCE AND MATHEMATICS EDUCATION

June 18 – 19, 2001

RESEARCH CENTRE FOR MATHEMATICS AND SCIENCE EDUCATION
University of Helsinki, Department of Teacher Education, Ratakatu 6 A, Helsinki, Finland

www.helsinki.fi
www.malux.edu.helsinki.fi/research/rmse2/index.en.htm

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**Foreword – welcome to Helsinki**

Welcome!

We would like to welcome all participants to the Second Scandinavian Symposium on Research Methods in Science and Mathematics Education.

The program consists of plenary sessions including three invited lectures, group works and participants presentations.

We would like to thank all the members of the scientific and organizing committee for their untiring efforts in preparing an enjoyable event of good quality

Veijo Meisalo
Conference Chair

Maija Aksela
Contact person
Table of Contents

Table of Contents................................................................................................................3
Program....................................................................................................................................5
Participants to Second Scandinavian Symposium in Research Methods on Science and
Mathematics Education........................................................................................................8
Invited speakers......................................................................................................................8
Participants............................................................................................................................8
Invited speakers’ abstracts .....................................................................................................9
Doctoral Studies in Chemical Education: U.S. Quality and Efficiency .........................9
  Prof. Henry W. Heikkinen, University of Northern Colorado. USA .........................9
Quantitative research methods.........................................................................................9
  Prof. Erkki Komulainen, University of Helsinki, Finland ...........................................9
Qualitative research methods.........................................................................................9
  Prof. Stephen Lerman, South Bank University, UK .....................................................9
Writing and publishing a scientific paper ......................................................................10
  Prof. Hans-Jürgen Schmidt Karlstads Universitet, Sweden ...................................10
Participants’ abstracts ........................................................................................................10
Students’ Discourse in a Modern Learning Environment – Towards Higher-Order
Thinking? .............................................................................................................................10
  Aksela, M., University of Helsinki, Finland .................................................................10
Semistructured interviews and group discussions as qualitative methods in biology
education...............................................................................................................................11
  Hagberg, M.& Lakomaa, E. Karlstad University .........................................................11
Understanding and reporting other peoples minds. ......................................................12
  Hannula, M. S., University of Helsinki ..........................................................................12
The Renewal of Physics Curriculum in Estonia: the Relation between Official and
Experienced Curricula........................................................................................................13
  Heinmets, T., University of Helsinki, Finland ..............................................................13
Demonstration and students' (age 16-17) understanding of combustion .....................14
  Lampiselkä, J., Vuolle, M. & Välijärvi, J. University of Jyväskylä, Finland .............14
Determination of Attitudes Towards Learning and Chemistry using Principal
Component Analysis............................................................................................................15
  Lundberg, B. K. S., Umeå University, Sweden .............................................................15
Facilitating the abstraction of the limit in a quasi-experimental design .......................15
  Merenluoto, K., University of Turku, Finland ..............................................................15
A research project: Teaching and learning kinetics and chemical equilibrium with
the help of computer-aided modelling activities...............................................................16
  Näätänen, E., SYK, Finland .........................................................................................16
Stimulated recall interview as a research method in learning and thinking of practical nursing students: patient transferring situation .......................................................... 17
Peiponen, P., University of Joensuu, Finland .................................................................. 17
Are Finnish Boys Better In Science? Gender Differences at the Item Level in TIMSS ...................................................................................................................... 18
Reinikainen, P., University of Jyväskylä, Finland .......................................................... 18
Finnish Mathematics Textbooks in Grades 5-7 .............................................................. 18
Törnroos, J., University of Jyväskylä, Finland ............................................................... 18
Computer simulated acid-base titration as prelab -effects on learning outcome .......... 19
Winberg, M., Berg A., & Lundberg, B, Umeå University, Finland ................................. 19
Background organisations ............................................................................................. 20
Sponsors......................................................................................................................... 20
## Program

**MONDAY June 18**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.00 - 10.00</td>
<td>Registration, Coffee</td>
</tr>
<tr>
<td>10.00 - 10.30</td>
<td>Opening of the International Symposium, Auditorium 1 &lt;br&gt;Prof. Veijo Meisalo University of Helsinki, Finland, &lt;br&gt;Prof. Hans-Jürgen Schmidt University of Karlstad, Sweden and &lt;br&gt;Prof. Maija Ahtee, University of Jyväskylä, Finland</td>
</tr>
<tr>
<td>10.30 - 12.00</td>
<td>Doctoral studies in chemical education -American quality and efficiency, Auditorium 1 &lt;br&gt;Prof. Henry W. Heikkinen, University of Northern Colorado, USA</td>
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<tr>
<td>12.00 - 13.00</td>
<td>Lunch break</td>
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<tr>
<td>13.00 - 14.30</td>
<td><strong>Program A: Group work: &quot;Doctoral studies in chemical education&quot;, seminar room 11.</strong> Prof. Henry W. Heikkinen, University of Northern Colorado, USA</td>
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<td><strong>Program B: Presentations of Participants, seminar room 13</strong> &lt;br&gt;Chair: Prof. Jaak Järv, University of Tartu.</td>
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<tr>
<td>13.00 - 14.30</td>
<td>13.00-13.30 Mariana Hagberg and Eeva Lakomaa, University of Karlstad, Sweden &lt;br&gt;&quot;Semistructured interviews and group discussions as qualitative methods in biology education&quot; &lt;br&gt;13.30-14.00 Päivi Peiponen, University of Joensuu, Finland &lt;br&gt;&quot;Stimulated recall interview as a research method in learning and thinking of practical nursing students: patient transferring situation&quot;</td>
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<tr>
<td>14.30 - 15.00</td>
<td>Coffee</td>
</tr>
<tr>
<td>15.00 - 16.30</td>
<td>Quantitative Research Methods, Auditorium 1 &lt;br&gt;Prof. Erkki Komulainen, University of Helsinki, Finland</td>
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<tr>
<td>16.45 - 18.00</td>
<td><strong>Program A: Group work: &quot;Quantitative Research Methods&quot;, seminar room 16</strong> &lt;br&gt;Prof. Erkki Komulainen, University of Helsinki, Finland</td>
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<td><strong>Program B: Presentations of Participants, seminar room 13</strong> &lt;br&gt;Chair: Senior Lecturer Matti Näsäkkälä, University of Helsinki, Finland</td>
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|              | 16.45 -17.15 Bruno Lundberg, Umeå University, Sweden <br>"Determination of Attitudes Towards Learning and
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
</table>
| 17.15 - 17.45 | Jarkko Lampiselkä, University of Jyväskylä, Finland  
"Demonstration and students' understanding of combustion" |
| 17.45 - 18.15 | Pasi Reinikainen, University of Jyväskylä, Finland  
"Are Finnish Boys Better In Science? Gender Differences at the Item Level In TIMSS" |

**Program C: Consultations as agreed**

<table>
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<th>Time</th>
<th>Event</th>
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| 19.00 - 21.00 | Evening Program: Fortum Oyj, Keilaniemi, Espoo [http://www.fortum.fi](http://www.fortum.fi)  
Dr Tech Vice President Tuomo Suntola, Strategic R&D, Corporate Technology.  
Buffet etc. |

**TUESDAY June 19**

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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| 09.00 - 10.30 | Writing and publishing a scientific paper Auditorium 1  
Prof. Hans-Jurgen Schmidt, Karlstadt University, Sweden |
| 10.30 - 11.00 | Coffee break                                                                                   |
| 11.00 - 12.30 | **Program A:** Group work "Writing and publishing a scientific paper", seminar room 11  
Prof. Hans-Jurgen Schmidt, Karlstadt University, Sweden |
| 11.00 - 12.30 | **Program B:** Presentations of participants, seminar room 13  
Chair: Senior Lecturer Kirsti Hoskonen, University of Helsinki |
| 11.00 - 11.30 | Markku Hannula, University of Helsinki, Finland  
"Understanding and reporting other peoples minds" |
| 11.30 - 12.00 | Jukka Törnroos, University of Jyväskylä, Finland  
"Finnish Mathematics textbooks in Grades 5-7" |
| 12.00 - 12.30 | Kaarina Merenluoto, University of Turku, Finland  
"Facilitating the abstraction of the limit in a quasi-experimental design" |
| 12.30 - 13.30 | Lunch break                                                                                   |
| 13.30 - 15.00 | Qualitative Research Methods, Auditorium 1  
Prof. Stephen Lerman, South Bank University, UK |

6
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>15.00 - 15.30</td>
<td>Coffee break</td>
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<tr>
<td>15.30 - 17.30</td>
<td><strong>Program A:</strong> Group work. &quot;Qualitative Research Methods&quot;, seminar room 11 Professor Stephen Lerman, South Bank University, UK</td>
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<td></td>
<td><strong>Program B:</strong> Presentations of participants, seminar room 13</td>
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<td></td>
<td>Chair: Assistant Veera Kallunki, University of Helsinki, Finland</td>
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<tr>
<td>15.30 - 16.00</td>
<td>Tiitu Heinmets, University of Helsinki, Finland</td>
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<td>&quot;The Renewal of Physics Curriculum in Estonia: the Relation between Official and Experienced Curricula.&quot;</td>
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<tr>
<td>16.00 - 16.30</td>
<td>Mikael Windberg, Anders Berg and Bruno Lundberg, Umeå University, Sweden</td>
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<tr>
<td></td>
<td>&quot;Computer simulated acid-base titration as prelab -effects on learning outcome&quot;</td>
</tr>
<tr>
<td>16.30 - 17.00</td>
<td>Elina Näsäkkälä, SYK, Finland</td>
</tr>
<tr>
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<td>&quot;A research project: Teaching and learning kinetics and chemical equilibrium with the help of computer-aided modelling activities.&quot;</td>
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<tr>
<td>17.00 - 17.30</td>
<td>Maija Aksela, University of Helsinki, Finland</td>
</tr>
<tr>
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<td>&quot;Students' Discourse in a Modern Learning Environment - Towards Higher-Order Thinking?&quot;</td>
</tr>
<tr>
<td>17.30 - 18.00</td>
<td>Closing of the International Symposium, Auditorium 1</td>
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<td>Prof. Veijo Meisalo, University of Helsinki, Finland</td>
</tr>
<tr>
<td>18.00 -</td>
<td><strong>Evening Program:</strong> A Visit to Suomenlinna</td>
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<td><a href="http://www.suomenlinna.fi">http://www.suomenlinna.fi</a></td>
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<td>Group leaders: Jari Lavonen and Matti Lattu</td>
</tr>
</tbody>
</table>
Participants to Second Scandinavian Symposium in Research Methods on Science and Mathematics Education

Invited speakers

Prof. Henry W. Heikkinen, University of Northern Colorado, USA
Prof. Erkki Komulainen, University of Helsinki, Finland
Prof. Stephen Lerman, South Bank University, UK
Prof. Hans-Jurgen Schmidt, University of Karlstad, Sweden

Participants

Arenö Inger, Karlstad University, Sweden
Berg C Anders R, Umeå Universitet, Sweden
Hagberg Mariana, Karlstad University, Sweden
Hakkarainen Olavi, Finland
Halkka Katri, Sibelius-lukio, Finland
Hannula Irma, University of Helsinki, Finland
Heinmets Tiu, University of Helsinki, Estonia
Häkkinen Kaija, University of Jyväskylä, Finland
Järv Jaak, University of Tarto, Estonia
Kankaanrinta Ilta-Kanerva, University of Helsinki, Finland
Karkkulainen Juha, University on Joensuu, Finland
Keinänen Heli, University of Turku, Finland
Kiviahde Maija, University of Oulu, Finland
Korventausta Ilkka, Uotilanrinteen lukio, Finland
Kurtén-Finnäs Berit, Åbo Akademi, Finland
Kärtä, Pirkko, University of Helsinki, Finland
Lakomaa Eeva, Karlstads Universitet, Sverige
Lampiselkä Jarkko, University of Jyväskylä, Finland
Lappalainen Annikki, University of Helsinki, Finland
Lehti Pirjo, University of Turku, Finland
Leinonen Liisa, University of Oulu, Finland
Lundberg Bruno, Umeå University, Sweden
Merenuoto Kaarina, University of Turku, Finland
Mäkelä Marja-Leena, Forssa Vocational Institute, Finland
Mäkinen Emilia, Finland
Nurkka Niina, University of Jyväskylä, Finland
Näsiikkälä Elina, SYK, Finland
Näveri Liisa, Finland
Peiponen Päivi, University of Joensuu, Finland
Partanen Anna-Maija, Rovaniemen kaupunki, Finland
Perkkilä Päivi, University of Jyväskylä, Finland
Pesonen Silja, University of Joensuu, Finland
Rantanen Pekka, University of Helsinki, Finland
Reinikainen Pasi, University of Jyväskylä, Finland
Röj-Lindberg Ann-Sofi, Åbo Akademi, Finland
Salonen Inari, Helsingin opetusvirasto, Finland
Soro, Riitta, University of Turku, Finland
Törnroos Jukka, University of Jyväskylä, Finland
Uitto Anna, University of Helsinki, Finland
Winberg Mikael, Umeå University, Sweden
Invited speakers’ abstracts

Doctoral Studies in Chemical Education: U.S. Quality and Efficiency

Prof. Henry W. Heikkinen, University of Northern Colorado, USA

Research and related professional work in chemical education represent a "growth industry" in the United States. This presentation will review the health and vigor (as well as some areas of concern) in that area of U.S. activity, focusing on university doctoral programs in chemical education. Particular attention will be focus to the 10-year-old Ph.D. program in Chemical Education at the University of Northern Colorado (UNC), which involves advanced studies in chemistry, chemical education, and work in supporting areas such as cognitive science, research design, statistics, science curricula, and pedagogical electives.

Candidates for that Ph.D. degree at UNC must demonstrate and defend their research competence in both chemistry and chemical education by completing both masters-level and doctoral-level research projects--one in chemistry, and the other in chemical education. In addition, they must demonstrate their instructional skills by co-teaching an undergraduate chemistry course with a supervising faculty member. Graduates of programs such as this prepare for careers in chemical education research and/or teaching at either secondary or tertiary levels, as well as for professional positions in science-education organizations, curriculum-development teams, and work in educational administration and policy.

The analysis of UNC's graduate-degree program in chemical education – which is coordinated and delivered within the Department of Chemistry and Biochemistry – will be mapped onto a review of current science-education reform issues and activity in the United States. Areas of needed research will be highlighted, and examples (some hypothetical) of both well-designed and less-effective research-based efforts will be considered.

Quantitative research methods

Prof. Erkki Komulainen, University of Helsinki, Finland

Research designs and natural conditions provide often a controversial situation in empirical research. The difficulties of correlative and quasi-experimental research "in vivo" conditions is dealt with. Special attention is given to the problems of before-after design's (repeated measures) statistical problems.

Qualitative research methods

Prof. Stephen Lerman, South Bank University, UK

Qualitative research methods are quite widely used in educational research although many national and international bodies are reluctant to accept results as convincing unless they are quantitative. At the same time in many countries there is a demand for research in education to be relevant to the classroom, and also that teaching should be seen as an evidence-based practice. In the UK £3m is given each year to teachers, each grant being less than £3k, to do research in their classrooms. There are some
tensions here which we will explore. The issue is one of methodology, or research paradigm. In looking at different ways to do qualitative research we will consider three key questions:

- How 'thick' should descriptions be?
- How can one evaluate qualitative research?
- Where is the researcher in the research?

Writing and publishing a scientific paper

Prof. Hans-Jürgen Schmidt Karlstads Universitet, Sweden

A well-prepared paper in science education should reflect the criteria defining educational research as a scientific discipline:

- Science produces new knowledge
- This knowledge should fit into a system
- Knowledge is produced in a systematic way.

The essential parts of a paper referring to these criteria are:

- Introduction/Background: reference to (1) and (2)
- Method: reference to (3)
- Results: reference to (2) and (3)
- Discussion: reference to (1), (2) and (3)
- Implications: reference to (1)

In preparing a paper special attention should be given to title and abstract, too. Very often these are the only parts that are read.

In this lecture more details are presented about preparing a literature review, describing the method of research and the discussion of research results. It may be difficult for younger researchers to have detailed knowledge about good journal articles. A "Scandinavian Workshop on Reading Scientific Papers" may be helpful.

The lecture will finally give information about the publication process and draw attention to strategic aspects.

References


Participants’ abstracts

Students’ Discourse in a Modern Learning Environment – Towards Higher-Order Thinking?

Aksela, M., University of Helsinki, Finland

There is a need to develop qualitative laboratory activities and interactive learning environments for chemistry education at secondary level. According to many research
papers student-centred higher-order cognitive skills (HOCS) – oriented learning environments and teaching strategies are especially needed in order to enhance chemistry knowledge acquisition from laboratory activities and to develop the skills. The main purpose of this study is to understand students’ cognitive study processes in a new modern laboratory environment by using their oral discourse in small groups as a primary source of evidence. Especially, the nature and quality of students’ discourse in a new modern laboratory environment designed for this purpose and its indicators of higher-order thinking were interested. In this study, real laboratory investigations in normal chemistry classes at secondary level were studied. The inquiry-oriented, project-like research tasks concerned of organic reactions and their properties. Data collection was done by using video recording method. Altogether there are 30 hours of video recordings were we can study students’ discussion.

For more detailed analysis the two most interactive of ten small groups were chosen. The data were analysed through writing protocols, edited into episodes and then classified into categories derived from the data. These categories were found to correspond to a model of Bennett and Dunne (1991)

Students' discourses seems to be very cognitively oriented. The ratio of higher-order and lower-order cognitively oriented discourse varies from task to task depending also on the group. However, there is a lot of action or lower-order oriented discourse which is regarded as essential for understanding and reaching higher-order thinking. Creating a concept map by the end of lesson, teaching the topic for other students and teachers’ questions seems to simulate discussion of the topic for higher-order thinking level. The real-time graphs on computer screen seems to simulate the discussion for the organic reactions and their properties (e.g. heat of reaction). It seems that this kind of modern learning environment encourages students for cognitively oriented discourse and study processes.

Semistructured interviews and group discussions as qualitative methods in biology education

Hagberg, M. & Lakomaa, E. Karlstad University

Background.

Aim of the study. Endeavouring a good research method in biology education This is a pilot study and aims at transferring the two methods, semistructured interviews and group discussions, for use in biology education. Since these two methods have earlier been used for research in chemistry education an attempt is now made to develop and test them for use in biology education. The research question for the study, with respect to biology education, is to evaluate students reasoning and understanding about the gas exchange in the human body.

Methods used.

Videotaped sessions of group discussions have been performed and analyzed. The groups consisted of biologystudents who had studied human physiology at university level. The size of the groups varied between seven and ten persons. A material intended to structure and focus the discussions of the students during the sessions was developed.

The topic and issue for the semistructured interviews were the same as for the group discussions. The same materials, with some modifications, as for the group discussions
were used during the interviews. The interviews were performed with two students at a time and tape-recorded.

The group discussions and the interviews were transcribed in full.

The material used will be presented and commented upon in the seminar.

Results.

The results with respect to biology education shows that the students discussed many aspects in the field of gas exchange in a more common way than expected. They also indicate that the more input of test-items given the more complex is the reasoning. It also became evident how quickly facts and concepts vanished from the minds of the students.

The results with respect to the methods indicates that the material developed for use in the discussions and interviews ought to be very well focused and structured towards the research question.

Implications for research.

A lot of subject matter knowledge, inspiration and creativity is needed to develop research material for the discussions and interviews in order to achieve a structure and a strong focus on the research questions at issue.

Status of research.

This is a pilot study and it will be continued. The results regarding the biological issue have not yet been entirely evaluated.

Understanding and reporting other peoples minds.

Hannula, M. S., University of Helsinki

The topic of my research is the development of students' attitudes to and beliefs about mathematics. For various reasons the study was designed as a longitudinal ethnographic case study of students in one class. Thus the topic of my research is the multiple ways my students feel and think about mathematics at different times and possible reasons for changes that take place.

The ontological nature of the research topic can be described using Popper's idea of three worlds. Popper distinguished three different worlds: the world of physical objects (1), the world of subjective experience (2), and the world of human creation (3). Each person has one's own world of subjective experience that is inaccessible to others. This problem must be overcome when one wants to study beliefs and attitudes. We shall shortly discuss other alternatives, and elaborate on the epistemology of studying subjective experiences through Word 3 objects (e.g. students' behaviour and their verbal and facial expressions). The problem of interpreting these as subjective experiences will be related to the subjective agency of the researcher. We shall focus on those instances, when the student's experience is not familiar to the researcher as a personal experience.

Methodological solutions for the discussed epistemological problems will be proposed. A narrow view of methodology as rules for collecting and interpreting data will be insufficient. Enactivist view focuses on researcher and underlines that his or her biases, theories, emotions, and modes of interaction all have an effect on what the researcher may find out in the research process. Enactivist methodology looks for
ways to make this process least restricted. The key elements are use of multiple perspectives and a large variety of data.

In a study of subjective experiences the issue of reporting findings is part of the methodology. The task of the researcher is to share the subjective experience of the student, and then communicate this so that the reader will be able to share it as well. I will argue, that a narrative mode of writing will be useful in some cases. Narrative mode represents knowledge in form of stories. Narrative mode is a more holistic way of knowing, and affective elements are more important in this mode. Narrative writing aims at assuring about the verisimilitude of the story; the reader ought to feel the story to be true.

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**The Renewal of Physics Curriculum in Estonia: the Relation between Official and Experienced Curricula**

*Heinmets, T., University of Helsinki, Finland*

The Research Methods of the Inquiry "The Renewal of Physics Curriculum in Estonia: Relation Between Official and Experienced Curricula".

My report is constructed in style where every researcher can find something for himself.

The aim of study: The renewal of physics curriculum in Estonia: to study the relation between official and experienced curricula. To make a new physics curriculum.

The background of study: There is a new social system and a new paradigm in Estonia. The connection between theory and practice is broken. New paradigm requires new study methods and materials, also new physics curriculum and new training of teachers.

The methods used: The methods of research work are functions of curriculum as a document, a phenomena (in this moment of time), a process in the longer period. The foreign research works have shown that the teacher himself is the best resource of information about his work and pupils (Houston, Haberman, Sikula, 1996). The Finnish questionnaire of Maija Aksela and Riitta Juvonen with some changes according to conditions in Estonia has sent to Estonian physics teachers in spring 2000. The quantitative and qualitative analyse of the answers has made. The case study is going on in one Estonian school in winter and spring 2001. The interviews, questionnaires, the results of study of pupils are used. The analyse of textbooks, of study materials, the integration with other subjects, the analyse of tests and exams are used. The project method 2001-2003 will be used for making a new model of physics curriculum and for practice it in 40 Estonian schools.

The results: The answers of the 153 physics teachers to questionnairy are used for preanalyse of situation in teaching physics in spring 2000 in Estonian schools. The case study is going on in spring 2001. The project is made for continue the research work.

A discussion of the results and the implications for research and practice:

The results were presentated by me in conference Modern (Real) Subjects and the New Curriculum in Tartu University in 2000, October 27-28. The requirements of society and learned in school material are not in correspondence. The hiddened curriculum is going on. There are the very different levels of pupils knowledge over Estonia. The minimum of knowledge and skills is not agreed, also the range and
extent of treatment of every concept, law law, theory, phenomena, also what kind of
tasks and problems to solve. The relation between practice and theory is broken in
every level in education of Estonia. There is a serious war of ideologies in the field of
education in Estonia.

The status of the research study: The research study is going on.

Demonstration and students' (age 16-17) understanding of combustion

Lampiselkä, J., Vuolle, M. & Väliljärvi, J. University of Jyväskylä, Finland

Students in senior secondary school have difficulties in understanding that
demonstrations are an essential part of chemistry instruction. Their understanding
about the origin of scientific knowledge, as well as about the role of experimentation
in the development of science, remains vague. Only rarely do demonstrations succeed
in constructing as adequate linkage between the theoretical base of the phenomena
and the cognitive and conceptual patterns pertinent to students at this level.

The aim of this study is to find and test means to develop the learning environment of
the senior secondary school so that it will enable students to understand the contents,
origins and characteristic of chemistry as a science and as a field of scientific
knowledge. This study describes students' conceptions about combustion and
highlights related implications with regard to the significance of demonstration in
chemistry instruction both in terms of teaching techniques and enhanced learning.

The methodological orientation is a quasi-experimental approach and, as well as an
approach derived from action research. In quasi-experimental approach, the process of
measurement leans on both the post-test-only design with non-equivalent groups and
the non-equivalent control group design with pre-test and post-test. The validity of the
measurement is reached by purposeful selection of the groups. In action research, the
process of producing new information leans on close cooperation with schools. The
study involved about 170 first-year students (age 16-17) of senior secondary schools

The results indicated that, regarding the phenomenon of combustion, students hold
miscellaneous notions, which is consistent with the constructivist learning theory. The
results also showed that understanding of the demonstrated phenomenon depended on
the context it was placed in. Quantitatively and qualitatively, the best results were
achieved when combustion was demonstrated to students in its own context. The
study also indicated that students could only poorly apply their theoretical knowledge
and that they held erroneous generalised ideas on combustion.

The distribution of students' responses across different categories was consistent with
the constructivist theory of learning. When explaining the phenomenon of
combustion, students used miscellaneous knowledge constructions deriving from their
own observations, prior knowledge and newly acquired concepts.
Determination of Attitudes Towards Learning and Chemistry using Principal Component Analysis.

Lundberg, B. K. S., Umeå University, Sweden

Attitude measurements were performed before and after a one-semester Chemistry course for six consecutive courses from 1999 until 2001. The questionnaires used were constructed with statements on both sides of a scale from one to five. The statements should be reasonable to answer at either side of that spectrum, giving us a measurement of the perception they have towards the scopes of learning, teachers responsibility, experimental work, examination and the role of chemistry in different contexts.

The datasets we got were analysed with programs for multivariate analyses normally used in Chemometry. The Principal Component Analyses gave us a model that in the last two tests was used to make small changes in the statements that were in some way misinterpreted or difficult to answer.

We could also identify students in low positions (LoPos) and high positions (HiPos) in their attitudes. Quite a few students were then interviewed in a semistructured manner and these interviews clearly show the validity of the data analyses. The shifts in attitudes shown after the course were small but overall negative. Different study groups (different incentives for learning chemistry, different background) showed a somewhat different attitude, e.g. different mean value, overall different shifts.

This report will show the construction and content of the questionnaire and explain how principal component analysis gives us a model in which we can see the consistency in the answers we get. In the model we can easily find information on which statements that are correlated. The response to other statements that shows up as outliers in the plots are from unique information. Some information can also be used to improve the questionnaire.

Facilitating the abstraction of the limit in a quasi-experimental design

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In educational context mathematics is considered to form a hierarchical structure that allows students to step by step enrich their knowledge. The difficulties students have in learning some advanced concepts in mathematics suggest that this is not always possible. One of the main reasons seems to be that the students' prior knowledge is in sharp contrast with the abstractions to be learned (Lehtinen, Merenluoto & Kasanen 1997; Merenluoto & Lehtinen, in press). For the learner two objects or relations are seen as similar to the extent that they fit the same abstraction; to fit something to an abstraction the learner must already possess that abstraction. In the classical view, generality is the product of learning. It is suggested, however, that abstraction is a prerequisite for learning (Ohlsson & Lehtinen 1997) and that the students' attention is deliberately focused to the essential features of the abstraction (Dreyfus 1991).

Based on the theoretical framework and earlier studies a quasi experimental design with pre and post tests was designed and carried out in upper secondary school calculus course. The subjects involved where a test group (n = 26) and two control groups (n =16 and n=31). All groups used the same text book in their study of
calculus course. The students in the test group were taught the abstraction of limit on the number line (a 3 hour intervention) in the beginning of the calculus course whereas the students in the control groups had their traditional calculus course. There were significant difference in the post test where the students of the test group gave fewer primitive level responses than in the control groups. The results from the experiment are promising for planning better learning environments for learning the abstract concepts of mathematics.

References


A research project: Teaching and learning kinetics and chemical equilibrium with the help of computer-aided modelling activities

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This work is based on a project that aims to promote the use of computer-aided modelling for chemical concept acquisition or investigation work in chemistry at the school level. The report discusses a study of students learning kinetics and equilibrium in chemistry in a planned teaching period. The main goal of the study was to investigate the ways in which the use of computer-based modelling activities can foster students learning. By focusing on students' cognitive and collaborative activities, the study highlights students' knowledge construction in modelling. Also the students' understandings of the chemistry concepts dealt with the modelling tasks are considered.

The research data consist of the pre- and post-test results and the students'actual works on the screen. The results show that the students'works reflect rather well the conceptual understanding. The coherent understanding of the chemistry concepts in modelling tasks indicates a good result in the post-test. It was also found that collectively produced models can lead to discussion on the profound meaning of concept.

The reliability and validity of the study still, however, need to be further developed in order to make any general claims of the effectiveness of the used teaching mode.
Stimulated recall interview as a research method in learning and thinking of practical nursing students: patient transferring situation

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Background and Aims

One of the important tasks in the work of practical nurses is handling clients. This particular study forms part of a broader research project (two researchers) centred on examining integration of teaching and learning of physics, nursing, ergonomics and rehabilitation. The present study is based on an action research project centred on developing a teaching module of physics needed in teaching ergonomics and handling, transferring and lifting clients. In this action research, the contents and realisation of physics teaching were developed and the conceptual problems in teaching and learning this module were determined.

The aim of present study was to analyse students' learning in the teaching module of physics and ergonomics they had half a year ago. The target group consisted of 14 practical nursing students in a vocational institute of social and health care education. Students were in their last term and their background varied considerably: there were differences in age (from 21 to 52 years), in previous education and in working experience. Two teachers, one science teacher (PP) and one ergonomics teacher, participated in this research.

Methods

The data were collected in normal class situations. Firstly, the ergonomics teacher videotaped a 2-hour lesson during which the students were asked to show how they act in a patient-handling task which they had learned half a year ago during physics and ergonomics lessons under the supervision of these same teachers. Students were working in groups of three or four persons; one student acted as a patient, two as nurses and the fourth as an observer. Secondly, stimulated recall interview with same student groups was used as a qualitative research method in the investigation of students' argumentation concerning patient transferring. This paper is based on this stimulated recall data. The students were interviewed while they were watching the video tape of their patient-handling task and were asked to analyse that task. The video was replayed to the students to stimulate their recall of their actions during the learning situation. Finally, the teachers were commenting students' working methods and the students again practised the same client-handling task with their teachers.

Results

The students had differences in the ways they applied the rules of physics and ergonomics to client handling. Students used mostly their own everyday language in their argumentation concerning the working methods. However, there were also differences how they used the concepts and contents of physics and ergonomics in their argumentation.

Discussion and Implications

Stimulated recall method is both a good research method and an efficient learning method. It gives valuable information about working methods and students' thinking and argumentation. However, the method requires some improvements in the future research.
Are Finnish Boys Better In Science? Gender Differences at the Item Level in TIMSS

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The aim of this paper is to highlight some of the reasons behind item-level gender differences found in the Third International Mathematics and Science Study (TIMSS) carried out in 1999. The gender differences between Finnish seventh-graders, 1471 girls and 1449 boys, in overall science achievement were very small, with the boys gaining a statistically significant superiority in scores over the girls only in physics. However, when the differences between the boys and the girls were studied at the item level, statistically significant differences could be found in 1/3 of the 146 science items. Almost 70 per cent of these differentiating items favoured the boys, particularly in physics, chemistry and earth science whereas the content areas of biology and scientific inquiry and the nature of science favoured the girls. A link was found between item type and gender differences. The extended-response items, which required students to interpret texts or diagrams in order to describe or explain procedures or scientific concepts, seemed to inspire the girls, who answered at greater length, more than the boys, who answered briefer. On the other hand, the multiple-choice items were found to work better for the boys. This paper includes also a qualitative content analysis of the science items where the items were classified into four performance expectation categories according to the illustrative skills and cognitive abilities that the items were designed to assess. The conclusion discusses the connection between gender differences and different performance expectations.

Finnish Mathematics Textbooks in Grades 5-7

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Recent studies have shown that to a very large extent, in comprehensive school Finnish teachers base their mathematics teaching on textbooks. Despite this, there has been little research on textbooks. The aim of this study was to examine the mathematical contents of Finnish mathematics textbooks for Grades 5-7. The study is based on the theoretical framework of the TIMSS studies (Third International Mathematics and Science Study), where the curriculum was considered to play a central role in education. The TIMSS framework curriculum has three levels: the intended, the implemented and the attained curriculum. Briefly, the intended curriculum consists of the objectives and contents of mathematics teaching defined at the system level, while the implemented curriculum refers to the mathematics taught in classrooms and the attained curriculum to the outcomes of schooling. In this model, textbooks are located between the intended and the implemented curriculum levels and are termed the potentially implemented curriculum.

Three mathematics textbooks used most often in each grade level were analysed, adopting the method of curriculum analysis applied in the TIMSS 1995 study. The textbooks were described from three viewpoints: the mathematical content, performance expectations, and perspectives used in the TIMSS 1995 mathematics frameworks. The main steps in the analytical procedure involved dividing the textbooks into blocks and then giving the blocks one or more codes describing their content and associated performance expectations.
In Grades 5 and 6, most of the textbook space was devoted to basic number concepts and their operations: whole numbers, fractions, decimal numbers, and in Grade 6, also percentages. Measurement was often discussed in connection with other subjects, especially decimal numbers. The differences between the content profiles of the textbooks used in Grades 5 and 6 were small. In Grade 7 the amount of textbook space devoted to the above number concepts was distinctly smaller, and as a new content integers were presented. Two-dimensional geometry dealing with polygons and circles was a shared content area emphasised in all seventh-grade textbooks. The content areas covered in them varied a great deal. The best example of this variation was equation-related mathematics, which accounted for about 25 per cent of the contents of one of the textbooks, while in the others it accounted for less than 5 per cent of the contents. The effect of the change from the spiral approach to course-based teaching in Grade 7 is easily discernible in the results. The variation in the contents covered increases considerably in this grade. Whether this causes variation in the learning outcomes is one of the questions that will be examined on the basis of the Finnish TIMSS 1999 results. A recent study found differences in learning outcomes among different textbook users in Grade 6. Could these be caused by the different approaches of the textbooks in question? Altogether, the study gives a good overall picture of the Finnish mathematics textbooks used in Grades 5-7, but at the same time it raises a great many questions for future studies.

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**Computer simulated acid-base titration as prelab -effects on learning outcome**

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From earlier investigations (Berg, Lundberg) we know that, during laboratory exercises, students tend to be more occupied with "getting things done" than reflecting over what actually is happening and from that making "thought through" decisions. In this investigation we are focusing on a laboratory activity dealing with the acid-base/buffer capacity concept.

In order to stimulate the development of an understanding of the theory behind buffer capacity and acid-base reactions we introduced a computer-simulated titration as pre-lab exercise. During this exercise the students were prompted to choose parameters for titrations, discuss the curves drawn by the computer and to write summaries of the discussions, which then were collected into a separate catalogue.

The student activities at the computers were automatically logged.

To evaluate the pre-lab. we:

1. investigated what types of questions the students made to the assistants during the laboratory exercise.
2. assessed the perceived learning outcome and relevance of the activity by a questionnaire administered to the students.
3. investigated the learning outcome of the laboratory activity from interviews with students selected on the basis of the questionnaire administered earlier

The data are currently being analysed and compared with earlier courses, which had no pre-lab. activity. The research question is: Did the computer simulation have any effect on the learning outcome? The results will be presented at the conference.
Background organisations

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