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SØR-TRØNDELAG
UNIVERSITY COLLEGE

Preface

NORMA05 is the fourth in a series of conferences on mathematics education starting in Lahti, Finland in 1994, and later followed by Kristiansand, Norway (1998) and Kristianstad, Sweden (2001). The theme for this year's conference, *Relating Practice and Research in Mathematics Education*, is intended to focus on how different practices in preparation for learning are related to teachers' views on the learning of mathematics, and how these views are related to basic theoretical aspects of mathematics education. Research in this tension between theory and practice will develop more knowledge about practices that can foster improved learning in mathematics, and therefore enhance knowledge about favourable approaches to education in school and to pre-service and in-service education of teachers.

The conference is organized by Sør-Trøndelag University College, and the organizing committee has consisted of Frode Rønning (chair), Heidi Strømskag Måsøval, Ole Enge, Geir Botten, and Ingvill Merete Stedøy. The scientific programme has been set up by an international programme committee consisting of Barbro Grevholm (chair), Heidi Strømskag Måsøval, Jeppe Skott, Christer Bergsten, Lisen Häggblom, Gudný Helga Gunnarsdóttir, and Janis Mencis.

The organizing committee would like to express its gratitude in particular to the Norwegian Ministry of Education and Research, the Nordic Graduate School in Mathematics Education, Norwegian Center for Mathematics Education, and Sør-Trøndelag University College for financial support, making the conference possible.

Master Schedule

Time	Friday	Saturday	Sunday	Monday	Tuesday	
0900-0930		Plenary lecture Simon Goodchild	Plenary lecture Birgit Pepin	Plenary lecture Markku Hannula	Plenary lecture Barbara Jaworski	
0930-1000						
1000-1030						
1030-1100		Coffee break	Coffee break	Coffee break	Coffee break	
1100-1130		Paper presentation 1	Paper presentation 5	Paper presentation 6	Paper presentation 8	
1130-1200						
1200-1230		Lunch	Lunch	Lunch	Lunch	
1230-1300						
1300-1330						
1330-1400		Paper presentation 2	Short communications and workshop	Paper presentation 7	Paper presentation 9	
1400-1430						
1430-1445		Break		Break	Closing session	
1445-1500		Paper presentation 3		Excursion to Trøndelag Folk Museum (Sverresborg) and Bymarka		NoGSME: Workshop on classroom research
1500-1545	Registration				Coffee break	Coffee break
1545-1615		Paper presentation 4	NoGSME: Workshop on classroom research continues			
1615-1700						
1700-1715	Opening session					
1715-1730						
1730-1800		Plenary lecture Mogens Niss				
1800-1830						
1830-1900						
1900-2000	Welcome reception					
2000	Dinner *	Dinner *	Dinner *	Conference dinner for all participants		

* Dinner on Friday, Saturday, and Sunday for participants staying at the hotel

Overview of paper presentations, short communications and workshops

All scientific activities will take place at the hotel in rooms named: Olav Tryggvason, Kristiansten, Sverresborg, and Austrått.

Paper presentations

	Session A <i>Olav Tryggvason</i>	Session B <i>Kristiansten</i>	Session C <i>Sverresborg</i>	Session D <i>Austrått</i>
Paper pres. 1 (Sat)	Erfjord	Kristinsdóttir	Kleve	Skott
Paper pres. 2 (Sat)	Fuglestad	Pálsdóttir	Gade	Schlöglmann
Paper pres. 3 (Sat)	Berg	Mosvold	Persson	Knudtzon
Paper pres. 4 (Sat)	Hundeland	Iversen	Bjarnadóttir	
Paper pres. 5 (Sun)	Kislenko	Carlsen	Måsøval	Fyhn
Paper pres. 6 (Mon)		Hansson	Braathe	Wæge
Paper pres. 7 (Mon)	Askevold	Juter	Yevdokimov	Hansen
Paper pres. 8 (Tue)	Bjuland	Lauritzen	Høines	
Paper pres. 9 (Tue)	Hedrén	Kristjánsdóttir		

Short communications and workshop (Sunday)

	Short communications			Workshop
	A: <i>Olav Tryggvason</i>	B: <i>Kristiansten</i>	C: <i>Sverresborg</i>	D: <i>Austrått</i>
13.30-14.00	Ambrus	Taflin	Tarp	Settemsdal,
14.00-14.30	Tan	Lingefjärd	Kudzma	Sivertsen and Stedøy
14.30-15.00	McIntosh	Hag	Lakka	

Programme

Friday 2nd September

15.00-17.00	Registration. Coffee and tea available
17.00-17.30	Opening Session: Music Welcome addresses by <ul style="list-style-type: none">- Torunn Klemp, Vice Chancellor of Sør-Trøndelag University College- Arnulf Omdal, Dean of the Faculty of Teacher and Interpreter Education- Barbro Grevholm, chair of the international programme committee
17.30-19.00	Plenary lecture. Mogens Niss: <i>The Concept and Role of Theory in Mathematics Education</i>
19.00-20.00	Welcome reception
20.00	Dinner for participants staying at the hotel

Saturday 3rd September

09.00-10.30	Plenary lecture. Simon Goodchild: <i>Students' Goals in Mathematics Classroom Activity</i>
10.30-11.00	Coffee break
11.00-12.00	Paper presentation 1. A: Erfjord and Hundeland, B: Kristinsdóttir, C: Kleve, D: Skott and Wedege
12.00-13.30	Lunch
13.30-14.30	Paper presentation 2. A: Fuglestad, B: Pálsdóttir, C: Gade, D: Schlöglmann
14.45-15.45	Paper presentation 3. A: Berg, B: Mosvold, C: Persson, D: Knudtzon
15.45-16.15	Coffee break
16.15-17.15	Paper presentation 4. A: Hundeland, Erfjord, Grevholm, and Breiteig, B: Iversen, C: Bjarnadóttir
20.00	Dinner for participants staying at the hotel

Sunday 4th September

09.00-10.30	Plenary lecture. Birgit Pepin: <i>Making Connections: An Exploration of Connections Made in and 'around' Mathematics Textbooks in England, France, and Germany</i>
10.30-11.00	Coffee break
11.00-12.00	Paper presentation 5. A: Kislenko and Grevholm, B: Carlsen, C: Måsøval, D: Fyhn
12.00-13.30	Lunch
13.30-15.00	Short communications (3x20 mins). A1: Ambrus, Hortobágyi, Näätänen, Liira, and Salmela, A2: Tan A3: McIntosh B1: Taflin B2: Lingefjärd B3: Hag C1: Tarp C2: Kudzma C3: Lakka Workshop (60 min) D: Settemsdal, Sivertsen and Stedøy
20.00	Dinner for participants staying at the hotel

Monday 5th September

09.00-10.30	Plenary lecture. Markku Hannula: <i>Understanding Affect towards Mathematics in Practice</i>
10.30-11.00	Coffee break
11.00-12.00	Paper presentation 6. B: Hansson, C: Braathe, D: Wæge
12.00-13.30	Lunch
13.30-14.30	Paper presentation 7. A: Askevold, B: Juter and Grevholm, C: Yevdokimov, D: Hansen
14.45-15.45	Workshop on classroom research. Simon Goodchild, Heidi S. Måsøval, and Barbara Jaworski: <i>Learning from students' talk in mathematics classroom</i>
15.45-16.15	Coffee break
16.15-18.00	Workshop on classroom research continues
20.00	Conference dinner

Tuesday 6th September

09.00-10.30	Plenary lecture. Barbara Jaworski: <i>Learning Communities in Mathematics (LCM): Research and Development in Mathematics Teaching and Learning</i>
10.30-11.00	Coffee break
11.00-12.00	Paper presentation 8. A: Bjuland, B: Lauritzen and Dysvik, C: Høines and Lode
12.00-13.30	Lunch
13.30-14.30	Paper presentation 9. A: Hedrén, B: Kristjánsdóttir
14.30-15.00	Closing session

Abstracts of plenary lectures

The Concept and Role of Theory in Mathematics Education

Mogens Niss

Roskilde University Center, Denmark

The notion of theory is essential in a discipline that thinks of itself as scientific or scholarly, as is the case with the didactics of mathematics, or - as the anglo-saxons seem to prefer – the field of mathematics education (research).

Now, on closer inspection, it is not clear at all what the term "theory" means in mathematics education. Nor is it clear where theories come from, how they are developed, and what sorts of foundation they have. This is not surprising as the didactics of mathematics, in addition to cultivating its own constructs, borrows from numerous other disciplines such as mathematics, psychology, anthropology, sociology, philosophy, education etc. And the notion of "theory" varies considerably across these disciplines, in particular, of course, between the sciences and the humanities.

Nevertheless this unclarity is problematic, not only because it gives rise to uncertainty about the extent to and the ways in which the didactics of mathematics is a scientific and scholarly discipline, but also because the use of mathematics education research to inform or influence the practices of mathematics teaching and learning may seem - to some - to rest on less than firm ground.

In this lecture I shall consider and review some prevalent conceptions of theory characteristic of mathematics education research and examine their roles in such research. In so doing I shall plead for the need for giving higher priority to discussions of the concept and role of theory than is currently found in the didactics of mathematics.

Students' Goals in Mathematics Classroom Activity

Simon Goodchild

Agder University College, Norway

My purpose in this presentation is to demonstrate how three theories of cognition can be used to provide complementary interpretations of students' learning activity in *regular* mathematics classrooms. I emphasise the word 'regular' because my purpose is to explore classes in, as far as possible, their 'natural state' and to introduce as little as possible from my own research agenda that might disturb and distort the interpretation of events. I will explain why I believe it is necessary for classroom researchers with an educational purpose to have a well developed theoretical framework and why, in my own work, I choose to work with three theories as a means of addressing the complex web of social interactions and individual student engagement. Stephen Lerman uses the metaphor of a 'zoom lens' to explain the application of different theories to examine classroom activity, I will explain why I prefer to use a metaphor of orthogonal projections. Whatever the metaphor the intent is the same, to gain a deep, rich and trustworthy explanation of what is happening in the classroom; in my work this means from the students' perspective.

Most people would accept that the central purpose of classroom research is to enhance the quality of teaching and learning. Advances in the technology of didactics or pedagogy depend, to some extent, on a proper understanding of what actually happens in the processes of teaching and learning. My research in mathematics classrooms is based on many years of experience as both mathematics teacher and teacher-educator, and it focuses on achieving a better understanding of teaching and learning mathematics in regular classrooms but to try to expose, especially, what it is like for the learner. In particular I have been interested to explore the nature of students' engagement in the tasks set by their teacher.

When I made the transition from teacher to researcher the driving force for my research was the work of Richard Skemp and Stieg Mellin-Olsen. Richard Skemp, in one place observes, 'if we want to know what someone is doing, we attach at least as much importance to their goals as to their outwardly observable actions.' Stieg Mellin-Olsen, writing with Geoffrey Howson, also asserts a strong relationship between effective classroom practice and students' rationales for learning mathematics. Thus, my focus on students' goals emerged as much from the literature of mathematics education as from my own experience in mathematics classrooms and my desire to see things from the students' perspective. Richard Skemp writes from the perspective of Constructivism, Stieg Mellin-Olsen from Activity Theory. More recently the development of a Theory of Practice by Jean Lave and others has proved influential in classroom research. I will set out my approach to develop a framework of students' goals within these theories, explaining their inconsistencies on the way, and how this can be used to provide complementary perspectives of students' learning activity in the classroom.

Making Connections: An Exploration of Connections Made in and ‘around’ Mathematics Textbooks in England, France, and Germany

Birgit Pepin

University of Manchester, UK

In order to refine our understandings of the teaching and learning cultures of the mathematics classroom in different countries, we need to refine our understandings of the teachers, the learners, the materials used for learning and the interactions between them. However, each of these is influenced, and in some cases determined, by the educational and cultural traditions of the particular country in which the teaching and learning takes place. Until we have a richer, more clearly articulated, and more detailed understanding of the ways each of these factors interrelate, educationists are likely to be pulled in inappropriate and ill-judged directions by policy makers intent on short-term, measurable outcomes of performance improvements in a narrow range of areas which are not only opposed to the values held by their own society, but also unworkable within the cultural traditions shaping it.

Students spend much of their time in classrooms exposed to and working with prepared materials, such as textbooks, worksheets and ICT materials. The main documents are the curriculum documents, which consist of curricula and textbooks. In recognition of the central importance of such documents, the framework for the Third International Mathematics and Science Study (TIMSS) included large-scale cross-national analyses of mathematics curricula and textbooks as part of its examination of mathematics education and attainment in almost 50 nations. It is reasonable to argue that such materials are an important part of the context in which pupils and teachers work. It is also commonly assumed that textbooks (with accompanying teacher guides) are one of the main sources for the content covered and the pedagogical styles used in classrooms.

The research reported here examines mathematics textbooks and the ways in which they are used by teachers in lower secondary mathematics classrooms in England, France and Germany.

The research literature reviewed raises important questions about textbooks as representations of the curriculum and about their role as a link between curriculum and pedagogy. Teachers, in turn, appear to exercise control over the curriculum as it is enacted by using texts in the service of their own perceptions of teaching and learning. In the presentation we explore the ways in which textbooks vary and are used by teachers in classroom contexts and how this influences the culture of the mathematics classroom. In particular we explore the ways connections are made at classroom level.

An analysis of the data suggests that learners in the different countries are offered different mathematics and given different opportunities to learn that mathematics, both of which are influenced by textbook and teacher. We contend that different countries provide different (mis)representations of mathematics for their students in schools, in particular with respect to connectivity. Whereas in some countries students are inundated with skills, procedures and disconnected mathematical knowledge, in others students are allowed to develop an appreciation of its interconnectedness and generalisable nature. It is argued that textbooks play an important part in the mathematics education process, and that both their content and mediation need to be understood in terms of a wider context, in order for shared understandings, principles and meanings to be established, whether for promotion of classroom reform or simply for developing a better understanding of this vital component of the mathematics education process.

Understanding Affect towards Mathematics in Practice

Markku Hannula

University of Helsinki, Finland

Psychological research that has been conducted in laboratory environments has been invaluable in our understanding of basic psychological processes of affect and it informs significantly to our understanding of how affect towards mathematics is involved in the self-regulation of students' mathematical behaviour. For example, we are aware of the effect an emotional state has on attention and memory. However, to understand affect towards mathematics in real-life situations, we face problems both theoretically and empirically. The theoretical problem stems from the complexity of the phenomenon in question. The more accurately any theory describes the complex intra- and interpersonal processes of affect and related factors in real-life situations the more clumsy it becomes as a tool for thinking. The empirical problem relates to the fact that only a minor fraction of affective phenomena can be observed directly while we usually need to rely on making inferences from the observable.

We see student's behaviour self-regulated and distinguish three main aspects of theory we need to take into account in order to understand affect: what does the person want, how does s/he see him/herself in the situation and what emotions one experiences in the situation. The want-aspect (motivation) aims at finding out the needs and goals that give direction to the behaviour. View of oneself in the situation sets the frame of possible actions and their expected outcome. Emotions function as one mechanism that regulates behaviour and mental processes in the direction determined by motivation. Within the context of mathematics learning the main question of motivation is whether the student really wants to understand the topic at hand or are other goals (e.g. interpersonal relationship goals) more important at the moment. The main question relating to one's view of oneself in the situation is one's confidence in solving the task at hand, but often there may also be different views about what the task really is about. The main question regarding emotional experiences is their personal dynamics in self-regulation. Is the student anxious or anticipating joy? Does frustration signal that the task is non-routine and interesting or does it signal that the situation is likely to lead to failure and thus threatening to self?

The empirical problem can be condensed into two questions: what can we observe, and how can we interpret it? Students' facial expressions, tone of voice and body language reveal much of their emotional experiences. Their choices tell about their wants, but also about their view of themselves in the situation. We can also interview students or give them questionnaires to fill, which will inform us about their wants, feelings, and view of themselves. With all these and especially with the last one we have to be aware of the multiple filters through which we can observe. Some of the affect is automatic and inaccessible to the person him/herself, some of it can be repressed as too painful and some of it may be hidden as socially inappropriate.

Whatever is observed can not be taken at face value, but need to be triangulated with other data. The most reliable source of information is the observable emotional expressions, because they can be only partially controlled consciously. Motivation, view of oneself in the situation and emotion are relevant in all studies that aim to understand affect in real-life situations. However, the research question at hand will place an emphasis on certain aspects and downplay others.

Learning Communities in Mathematics (LCM): Research and Development in Mathematics Teaching and Learning

Barbara Jaworski

Agder University College, Norway

Research suggests that students in Norway, along with many other countries, are not achieving in mathematics as highly as society and the education system would like. The complexity in which learning takes place – school systems and society expectations, curriculum and assessment structures, human relationships – is such that we cannot suggest simple reasons or solutions. One line of thinking is that *teaching* should improve. But *how* should it improve? What are *better* ways of teaching that would achieve the results we should like to see? Who is responsible for achieving better ways of teaching? There are many answers to such questions and many approaches to finding solutions.

In the LCM project we focus on two sources of knowledge and experience, those of teachers in schools and of didacticians in higher education, and try to combine these to explore ways of developing teaching and hence of learning mathematics. A fundamental aim of the project is to create learning communities in which all practitioners, didacticians, teachers and students are learners. We seek to learn about ways of teaching mathematics that enable students to be successful learners of mathematics. Our approach is one of inquiring into a range of questions (some are given below) about the teaching and learning mathematics in classrooms, drawing on our joint experience and the professional, academic and research literature.

We draw on theory about “inquiry communities” which proposes that when people engage in inquiry together, learning takes place. Inquiry includes asking questions, making investigations and searching for knowledge. Research itself involves inquiry. We see inquiry both as a tool for exploration of fundamental questions and also as *a way of being* developing within an inquiry community. Developing such a “way of being” means that we start to act in an inquiry fashion as part of our normal day to day activity. Activity that is inquiry based involves exploring the outcomes of our practice as we work from day to day, and feeding back what we learn into our ongoing practice. It involves inquiring into mathematical problems as part of classroom learning. I refer here particularly to practices of teaching and also to practices of research in which we try overtly to learn more about teaching and research and hence to develop them both.

In the LCM project a team of 12 didacticians, 8 schools and 40 teachers are developing communities of inquiry through the activity of the project. Research in the project is studying this development. What is the nature of community in the college, in each school, in schools and college together? What does inquiry look like in each of these settings? What kinds of activity are taking place in classrooms? What is the nature of students’ activity and what and how are they learning mathematics? What are the issues that arise when teachers try to work in inquiry ways in their classrooms? How does this fit with the ‘normal’ ways of working and expectations of schools with respect to curriculum, tests and societal demands?

At the time of the talk, the project will have worked through one complete phase (one year) and will be about to embark on Phase II. I shall report on findings that have emerged from our analyses to date.

Abstracts of paper presentations

Paper presentation 1

Ingvald Erfjord and Per Sigurd Hundeland: Teachers' reflections on the use of ICT tools in mathematics: Insights from a pilot study

This paper is based on data from a case study at a secondary school in Norway. The aim of the paper is to present and analyse the nature and content of two teachers' reflections on the use of ICT tools in mathematics at grade 9. A central method in the study is a focus group interview of two teachers reflecting on use of ICT in their mathematics teaching, recalled by a video recording of three students work in their lesson. A tabular is presented with questions addressing the reflections from the teachers. The tabular indicates teachers' ability to address a variety of questions, both linked to the concrete activity recalled by the video and on a more general level of ICT teaching in mathematics.

Jónína Vala Kristinsdóttir: Teacher research in mathematics teaching

The research study focuses on the development of an experienced elementary teacher during a 3-year period of teaching mathematics. It provides an account of the interaction between teacher and students and its effect upon teacher development. The purpose of the research was to study how enhanced meta-cognitive thinking can result in development that is valuable for the teacher's work. The teacher's attitudes to the profession and teaching mathematics in particular are described and the effect of the teacher's own teaching and learning experience on attitude development is analyzed.

Bodil Kleve: A study of teachers' views on the teaching and learning of mathematics, their intentions and their instructional practice

This is an ethnographic study of how teachers in lower secondary school are implementing the current mathematics curriculum, L97, in Norway. The methodology in the study includes focus groups conversations, individual conversations, self estimation and classroom observations. I found different degree of coherence between what teachers say they do and what they actually do in the classroom. In this paper I focus on the methodology and the analysis of data from one teacher who wants to focus on students' conceptual understanding in mathematics as L97 does, rather than exercising drill and procedures. Also constraints possibly preventing him from carrying out "ideal" teaching and some of L97's recommendations are considered.

Jeppe Skott and Tine Wedege: Researching potentials for change in attitudes and practices

This paper reports on the design and methodology of an ongoing study in belief research. The study addresses the question of the potential and perceived influence of the KappAabel competition on the mathematical attitudes and practices of the participating teachers and students. We shall outline our main methodological considerations and also discuss, and to

some extent challenge, what we consider dominant approaches to research on teachers' beliefs. We have tried to address three interconnected methodological difficulties: (1) As far as possible using conceptual frameworks that are well grounded empirically; (2) Seeking to adopt a teacher's perspective by ensuring that their views of mathematics are not overemphasised in descriptions of their educational decision making; (3) Acknowledging that no terminology carries unequivocal meanings and that therefore more than an indication of agreement or disagreement with the rhetoric of reform is needed to outline teachers' and students' school mathematical priorities.

Paper presentation 2

Anne Berit Fuglestad: Students' attitudes, choice of tools and solutions of mathematical tasks in an ICT rich environment

In a three year development and research project in lower secondary school the aim was to develop and study students' competence to use ICT tools and to make reasonable choices of ICT tools to solve mathematical problems. In the last term the students were given 12 tasks to work on for 8 – 10 lessons, and the opportunity to choose what tasks to solve and what tools to use; ICT tools or other aids. This paper will present some of the students' solutions based on observations, their solutions in computer files and answers to the questionnaire given in close connection with the work. The students were asked some attitude questions and asked what tools they choose for a specific task and why. Finally, the paper will outline a subsequent project which aims to build learning communities with teachers and didacticians in order to develop ICT competence and use of ICT in inquiry processes in mathematics.

Gudbjörg Pálsdóttir: Girls' beliefs about the learning of mathematics

Increased attention has been placed on research on beliefs about mathematics and mathematics education and it has become one of the central elements of the study of mathematics education. A qualitative research study was made on the beliefs of four Icelandic teenage girls about mathematics, the study of mathematics, and themselves as learners of mathematics. Their descriptions and thoughts are viewed in the light of theories and newfound results of overseas research on girls' beliefs about mathematics and the study of mathematics. The main conclusions of this research are that these girls

- view mathematics as a process
- place emphases on understanding and solving the problems at hand
- are self-confident, well organized and study hard
- seldom use elaboration strategies.

Sharada Gade: Artefact mediated classroom practice

This paper reports on a classroom study of mathematical meaning being made by students working in small groups in an upper secondary school in Norway. A naturalistic study it observes student activities within the classroom from a socio-cultural perspective. It addresses the artefact mediated classroom practice, wherein student participation and meaning making is guided and apprenticed by the teachers. Mediated by artefacts within intentional practices,

the mathematics classroom constitutes a culture which is also the medium for meaning making.

Wolfgang Schölglmann: Mathematics learning without understanding – cognitive and affective background and consequences for mathematics education

Mathematics learning without understanding and learning by rote is a widespread phenomenon. But learning by rote contradicts the view that learning – especially mathematics learning – necessitates understanding. The present paper tries to illuminate this phenomenon from the cognitive as well as the affective viewpoints. Recent results from neuroscience are used to understand the process of such learning. These results suggest that this kind of learning is based more on the form of the description of a problem than on its content; and therefore that this “knowledge” is very inflexible and not transferable to other problems. Consequently – if acquiring competencies that are useful outside school, too, is the goal of mathematics learning at school – efforts in the classroom towards developing concepts and using demanding problems ought to be intensified.

Paper presentation 3

Claire Berg: Focus on teachers’ reflections and the role of the researcher in collaborative problem solving in algebra: Building a learning community

This paper is related to my ongoing research concerning the possibility to enhance the learning and teaching of elementary algebra through the creation of a learning community. It explores teachers’ reflections when engaging in problem solving related to elementary algebra in collaboration with a researcher; and also the role played by the researcher. The data presented here illustrate the way a community of teachers and a researcher engaged in a mathematical task through their reflections emerging from this process. Preliminary results suggest that engaging in such activity increases teachers’ awareness of their own ways of working in mathematics and of the complexity of the teaching situation.

Reidar Mosvold: Teaching "mathematics in everyday life" - A case study of one teacher's beliefs and actions

In L97, the Norwegian national curriculum of 1997, "mathematics in everyday life" was presented as a new topic. As opposed to the other topics, like numbers and geometry, mathematics in everyday life was supposed to be more of a meta-topic, establishing the subject in a social and cultural context. The idea was that mathematics in everyday life should be incorporated in the overall teaching of mathematics, rather than being a distinct topic on its own.

This idea has proven hard to incorporate though, and evaluation studies have shown that teachers still teach in a traditional way. This presentation will give some practical examples of how the connection between mathematics and everyday life can be carried out, based on a

case study of an experienced teacher, and the main concepts concerning mathematics in everyday life will be discussed.

Per-Eskil Persson: Teacher as researcher: teaching and learning algebra

For the investigations of which factors that facilitate or obstruct the students' learning of algebra at upper secondary level, we performed a longitudinal study using two groups. The aim of this paper is to describe and discuss how my research and its results, together with the theories connected with it, helped me to interpret and understand better what happened in the classroom and how theories and research could be used to improve my own teaching practice. It also intends to show the relationships between the challenges of having the double role as both a teacher and an observer and the benefits of doing action research, both for the students and for the teacher/researcher. Finally, I discuss how the process of going through a research education has affected me as a person.

Signe Holm Knudtzon: Numeracy among six-year-old children

What kind of mathematical knowledge do children have when they start school? How can we assess it, and how do we develop this knowledge in basic mathematics education? Eighteen Norwegian six-year-old children in grade 1 are videotaped when being assessed in a test situation developed in Canada. The presentation shows videotapes and discusses the kind of knowledge that the children show and the challenge teachers are faced with. The children are given tasks related to numbers, pattern and shapes and their score is graded on five different levels. The children show different profiles in their score when it comes to visual-spatial items, number skills and number concepts. The material shows that there is certainly reason to be fascinated and surprised by the ability of young children to think, explain and solve problems.

Paper presentation 4

Per Sigurd Hundeland, Ingvald Erfjord, Barbro Grevholm, and Trygve Breiteig: Teachers and researchers inquiring into mathematics teaching and learning: The case of linear functions

The LCM- project (Learning Communities in Mathematics) is run by researchers at Agder University College and teachers from nearby schools. The project emphasises community-building and inquiry. We expose from the project a well planned teaching lesson in an eleventh grade class. Data will illustrate how the teachers intervened to reach certain goals that were identified during the planning process. These interventions resulted in discourses, which showed that there was an inconsistency between how the teachers interpreted and used certain words as a mathematical concept and how the students interpreted the same word. The findings may be seen as common challenges when trying to build up a community of inquiry in the classroom.

Kjærland Iversen: Students' response to one-object stochastic phenomena

Four hundred and sixty-three students in lower secondary school (age 13-16) were asked to solve several probabilistic problems in a written test. In this paper we will consider their responses to three of the tasks that were related to compound stochastic events. The aim of the investigation has been to consider logical inconsistencies in students' answers. In each task a question was presented to the students in two different ways. To dig more deeply into the students reasoning about these tasks, thirty-eight of the students participated in a clinical interview about one of the tasks. In the first part of the study a high degree of inconsistency was found in the responses for all age groups. Another interesting finding was that the percentage of the students showing the equiprobabilistic misconception *increased* with age. Only preliminary results from the qualitative part of the study are reported.

Kristín Bjarnadóttir: The concept of “understanding”

The importance of “understanding” concepts and procedures is emphasized in all articles on mathematics education and prefaces to most mathematics textbooks written in Iceland from the 18th century to present days. However, assertions are found, made in regular interval, e.g. in the 1780s, the early 1900s, the 1960s and even in 2005, stating that the emphasis on “understanding” in mathematics is a novelty, not promoted in earlier times. An attempt will be made to analyze what lies behind these assertions, how the prevailing situation was at their time, what the authors suggested for improvement and how their suggestions relate to modern ideas about “understanding” in mathematics. Furthermore, the basic meaning of the Icelandic word “skilja” will be compared to the corresponding words “forstå” in Danish and “understand” in English if that might throw light on these statements.

Paper presentation 5

Kirsti Kislenko and Barbro Grevholm: Attitudes and beliefs about mathematics among students in Norway and Estonia

Students' beliefs and attitudes towards mathematics teaching and learning is the focus of the study described in the paper. Some preliminary results from research carried out in Norway in 2005 are given with focus on the students from the first year in upper secondary school. The answers from seventh grade students in 2005 are briefly compared to students' responses from 1995 when corresponding data was collected within the KIM project in Norway. Both of these studies use a questionnaire elaborated in 1995. Some of the aspects related to a similar study amongst Estonian students, that will take place in spring 2006, are discussed in the paper.

Martin Carlsen: Geometric series and mathematical understanding

This paper discusses upper secondary students' conceptual understanding of geometric series. Analyses of student dialogues in a collaborative problem-solving small group are conducted to identify what the students are doing together mathematically when working on and discussing mathematical problems. The analytical approach puts emphasis on the words the

students use, how they use concept-related definitions and formulae, and the students' argumentation when discussing and applying the concept. The analyses show both mastery and appropriation of the concept of geometric series, although the students' use of ordinary and formula-related words and argumentation indicate some understanding difficulties.

Heidi S. Måsøval: Empirical and theoretical reasoning in student teachers' small-group work on an algebraic task

The object of this paper is to present an analysis of an observation of three student teachers' collaborative work in a problem-solving context. The episode presented reveals incidents of specializing, conjecturing, generalizing, and convincing. Garofalo and Lester (1985) have suggested that students are largely unaware of the processes involved in problem solving and that addressing this issue within problem solving instruction may be important. The analysis of the episode described shows on one side how a reasoning process is constrained by the didactical contract (Brousseau, 1997), and on the other side how the work is progressing as a consequence of the interaction between the student teachers. Manipulatives used are here seen to be important for an increasing sophistication in their use of language.

References:

Brousseau, G. (1997). *Theory of didactical situations in mathematics*. Dordrecht: Kluwer.
Garofalo, J. & Lester, F. K. (1985). Metacognition, cognitive monitoring, and mathematical performance, *Journal for Research in Mathematics Education*, 16, 163-176.

Anne Birgitte Fyhn: Sami culture as basis for mathematics teaching

A QRS-system (Barton, 1999) is a meaningful system that for a given group of people gives meaning to Quantity, Relations and Space. Each cultural group have their own QRS-system. This paper aims to point out how the the sámi culture's elements lavvu, lasso and duodji can function as basis for mathematics teaching. At first the elements are divided into two groups, those mainly categorised as R and those mainly categorised as S. Then there will be pointed out possibilities for how to use these elements in mathematics teaching and finally one example of how the lasso is used in geometry teaching for pupils in Northern Norway.

References:

Barton, B. (1999). Ethnomathematics and Philosophy, *Zentralblatt für Didaktik der Mathematik*, 31 (2), 54-58.

Paper presentation 6

Örjan Hansson: Preservice teachers' conception of the function concept, its significance in mathematics and presence in school mathematics

The purpose of this study is to examine preservice teachers' conceptions of the function concept as well as their conceptions of the significance of functions in mathematics and the presence of functions in school mathematics. A further purpose is to study the effects of an Intervention regarding the function concept. Two groups of preservice teachers specializing in

mathematics and science are participating in the study. The findings indicate changes in the preservice teachers' view on the function concept related to the intervention and different themes of relevance in their reasoning on the significance and presence of functions in various contexts.

Hans Jørgen Braathe: Identity and agency in mathematics teacher education

The paper will present a communicational view on teaching and learning as a theoretical frame for analysing student teachers' texts. To discuss this, the paper analyses theoretical frameworks presented by D. Holland, D. Skinner, W. Lachicotte Jr. and C. Cain in the book "Identity and Agency in Cultural Worlds". The texts analysed are texts produced by the student teachers during their compulsory mathematics course in their pre-service teacher education. The students' texts are about their learning and are seen as reports of their perception and understandings of the figured worlds of mathematics education in which they participates as learners, to indicate their positionings and reflections of their authoring of identities as learners and performers as teachers of mathematics. Text in this connection will also include mathematical text, seeing mathematics as a semiotic sign system.

Kjersti Wæge: Motivation - a key to learn mathematics. How can motivation be measured?

The Ph.D-study, *Making mathematics meaningful – from the students' point of view*, is an action research project. The objectives include: 1) To develop student projects and tasks showing the relevance of mathematics in everyday life and inviting the students to be active and to explore. 2) To investigate possible changes in the students' motivation to learn mathematics in terms of cognition, emotion and behaviour and in their development of mathematical competence. The case study includes one class (age 16) and their teacher. In this presentation my focus is on students' motivation. In my presentation I will give some examples showing what kind of mathematical approach the students are offered. I will also present an analysis of two semi-structured interviews of students. My hope is that the teachers can use the instrument I am developing to assess their students' motivation for mathematics.

Paper presentation 7

Gjert-Anders Askevold: The mathematical textbook as a semiotic tool: A study of high school students solving assignments in collaborative small group work: A dialogical approach

This paper reports research that is concerned with high school students working collaboratively in a problem-solving context. The aim of my thesis is to identify what is used as textbook, and in which ways the students use it in work with mathematical problems. This study shows how a group of five 3MX students uses written mathematical sources in mathematical work, how they use the textbook, assignment book, formula book, lecture notes and themselves to learn the language mathematics. The mathematical textbook and the semiotic resources in it are created for making communication of mathematics easy. My study however shows that students, when working with mathematics, do not tend to use the

textbook. They often prefer other sources like the formula book or fellow students if they have a mathematical problem.

Kristina Juter and Barbro Grevholm: Limits and infinity - A study of university students' performance

Students' work with limits of functions includes the concept of infinity. Both concepts are complex but necessary for mathematics studies at university level. A study of student solutions to limit tasks was conducted to reveal how limits of functions and infinity were handled by the students at a Swedish university. As a background to the students' and teachers' situations we have also analysed textbooks and curricula. One result is that many students were unable to handle limits correctly for various reasons. Some of the students gave correct answers with incorrect explanations to tasks. Textbooks used at upper secondary schools do not provide much theory or tasks about limits and infinity so most new students at universities do not have a sufficiently developed representation of the concepts. The students hence need to be in an environment, which supports them well in their learning of limits of functions and infinity.

Oleksiy Yevdokimov: Stimulating inquiry activities in a classroom: An approach to pre-service education of teachers of mathematics

The aim of the paper presentation is to describe research, which was carried out to investigate an approach to pre-service education of teachers of mathematics. The approach was based on learning and teaching through inquiry some courses for teacher students simultaneously. All activities in the scope of research as well as teaching the courses were in a constructivist learning environment in a classroom. Two different forms of inquiry work were used in the research.

Analysis of the research results gives possibility to state that this approach contributes to teacher students' deeper understanding the role of inquiry activities and inquiry process in learning mathematics and develops their skills to conduct inquiry work in a classroom.

Torkel Haugan Hansen: How to investigate tacit knowing as a dimension of adult numeracy?

One of the research questions in my current Ph.D-work is: Which aspects of numeracy and mathematics are involved in the daily life of competent workers from three different sectors (building industry, nursing and sales & service) with no formal mathematics education? I use the operationalization of the concept of tacit knowing made by Nonaka and Takeuchi in combination with the method developed by Tine Wedege for investigating adult numeracy in the workplace, to investigate the tacit dimension of adult numeracy. This paper will present a preliminary analysis of fresh data collected from two workers in the same trade, but in workplaces with totally different size and structure. This will give two different contexts when it comes to the organization of the work, work broadness and complexity.

Paper presentation 8

Raymond Bjuland: Collaborative problem solving in geometry without teacher intervention

This paper reports research that focuses on student teachers working collaboratively in a problem-solving context without teacher involvement. One episode from the group discussion has been chosen to illustrate how elements of the students' reasoning process are revealed in dialogues. The students' use of different strategies have also been identified by taking a situational, socio-cognitive approach to studying communication and cognition. In their attempts at coming up with a solution to one of the problems, the students discuss different ideas and geometrical concepts. The analysis puts emphasis on how they attribute meaning to the concept of similarity. It is also natural to ask when it is suitable for a visiting teacher to become involved in the group discussion.

Pål Lauritzen and Anders Dysvik: Relations between approaches to learning and conceptual understanding in mathematics

This paper addresses students understanding of mathematics in higher education in relation to their preferred approach to learning. Some focus their attention toward memorizing facts with less attention of understanding principles and concepts, while others are trying to relate new knowledge to their previous knowledgebase trying to see relations and understand theories. These two approaches are known in the educational psychology literature as surface and deep approaches to learning.

Studies in mathematics education have been occupied by characterizing how mathematical concepts are understood. This paper confirms that students tend to have individual priorities with respect to learning approaches when learning mathematics. The paper also relates learning approaches to achievements with respect to procedural and conceptual understanding.

Marit Johnsen Høines and Beate Lode: Communication on mathematics within practice in teacher education: An investigative approach

The presentation refers to a project where we investigate the nature of and conditions for a subject based and reflective approach in the context of practice as part of the study in mathematics education as part of teacher education. We invited five students and their tutors to investigative cooperation. Observations from teaching-learning situations where students were teaching served as common references for conversations afterwards, and for individual interviews. We wanted to experience and discuss the nature of the didactical "afterwards-conversation". On a preliminary stage we identified two different and partly conflicting approaches; *an evaluative* and *an educative* approach. In this presentation we discuss how these approaches appear in the conversations as we discuss some methodological aspects of the project.

Paper presentation 9

Rolf Hedrén: Problem solving – Do the pupils learn?

This study forms a part of a project, RIMA, where pupils aged 13 – 16 years and their teachers were working with ten so called rich problems during mathematics lessons. In this paper I discuss the work of two groups which were video and audio tape recorded during their work. They were also interviewed individually after the problem solving sessions, and their written solutions were collected. In this way I tried to find out what opportunities for learning arose during the problem solving and how the pupils made use of these opportunities. I found that the pupils, though bewildered in the beginning, could find procedures and strategies to solve the problem and in that way got a better understanding of the concepts involved.

Anna Kristjánsdóttir: Challenging questions about: Relating practice and research in mathematics education

Outsiders of the educational community, such as parents and most adults, tend to view mathematics and mathematics learning in a simplified way, not needing in-depth discussion. There are many reasons. However in learning and teaching of mathematics outsiders play an important and decisive role. *Challenging question 1: Will students benefit, on any large scale, in learning mathematics, suitable for their life, from a partnership only between teachers and researchers, only between practice and research?*

During the last decade many political and administrative authorities have focused on mathematics in schools. Effective change is expected and the financial means provided for in-service teacher courses. Often these are short and closer in character to an *acquisition metaphor* than a *participation metaphor of learning*. A teacher's ability to transform practice and sustain development is not questioned. *Challenging question 2: What does it take for a school to become a developing community in mathematics learning?* This can neither be prepackaged or "borrowed", however the creation can draw on the Design Based Research paradigm and research on Knowledge-Building Communities.

Abstracts of short communications

András Ambrus, István Hortobágyi, Marjatta Näätänen, Riitta Liira, and Maija Salmela: Why do we complicate the solution of the problem?

Mathematics Education cultures may be very far from each other in different countries. For example the Nordic versus Middle-European mathematics teaching styles have their own special characteristics. On the Finnish-Hungarian mathematics summer camps we usually ask the Finnish students and their teachers – using questionnaires and writing comments – to reflect on the mathematical activities, problems realized in the camp courses. Analysing a concrete example and students' and teachers' comments we try to illustrate: it is possible to change the views of practicing teachers, using mathematical problems and activities based on relevant theoretical backgrounds.

Eva Taflin: What influences the teachers in problem solving?

This study is a part of a greater project that is called RIMA (Rich Mathematical Problems), where 4 classes (pupils aged 13 – 16 years) and their teachers worked with 10 rich problems (problems that fulfil 7 criteria) during their lessons in mathematics for three years. The teachers were interviewed before and after their lessons. In this presentation I want to tell in what way this teaching influenced the four teachers. One result is that the teachers found that all pupils could work with the problem and achieved better than expected. At the same time they displayed pleasure in their work. Another result is that even if the RIMA problems implied another way of teaching, the teachers expressed their intention to continue as usual.

Allan Tarp: Fractions or decimals, single or multi-stacks

To solve the irrelevance-paradox of modern mathematics education research, postmodern counter-research identifies blind spots in modern research. Where the modern library-based Top-Down LIB-mathematics from above sees its concepts as examples of abstractions, its opponent, postmodern laboratory-based Bottom-Up LAB-mathematics from below, sees concepts as abstractions from examples. Thus LIB-mathematics sees decimals as examples of fractions, whereas LAB-mathematics sees fractions and decimals as abstractions describing the organising of multiplicity in stacks in two different ways, the latter being adopted in our number system.

Gülçin Tan: Teachers' and students' perceptions about the newly developed mathematics curriculum: A case from Turkey

The purpose of the study is twofold: (1) to find out how the 5th grade classroom teachers and the students perceive the newly developed mathematics curriculum (NDMC), and (2) to investigate how the NDMC is put into practice. The study was conducted with a sample of sixty-five 5th grade students and two 5th grade classroom teachers from one of the pilot schools in Ankara, Turkey. The data were collected both qualitatively and quantitatively. The results indicated that the most of the students believed learning mathematics was enjoyable

and easy in the NDMC. For the teachers, the NDMC reflects constructivist approach and provides opportunities for the students to learn mathematics with understanding. Generally, both the teachers and the students are satisfied with the NDMC.

Thomas Lingefjärd: On teaching problem solving and solving the problems of teaching

George Polya's first principle in teaching is what he defined as active learning: "let the students discover by themselves as much as feasible under the given circumstances". I have found that by adopting this principle, many students change their attitudes towards mathematics and becomes more involved in the subject. Besides from the more immediately reaction in the classroom, it also resulted in more students selecting mathematics as a continuation course in their teacher program. So even if it is difficult to engage students during a 90 minutes lecture, the benefits have proved to be substantial, which I hope to be able to describe at the NORMA 2005 conference.

Richardas Kudzma: Algebra-geometry relation in teaching functions and calculus

Algebraic calculations, formal applying of formulas very often dominates in mathematics classes. Such teaching distorts the essence of mathematics and forms bad opinion on the subject in society. Situation can be corrected by including much more geometry into the algebra and calculus. This stimulates deeper understanding of mathematics. A few examples showing harmony between algebra and geometry are presented in the article. Emphasis is done on direct-inverse functions relation, their geometrical interpretation and its applications. One problem from Vilnius University students examination papers has been discussed.

Alistair McIntosh: A strategies approach to mental computation from years 1 to 10

Many countries are moving from an over-emphasis on written computation to a greater emphasis, particularly in the early stages, on developing mental computation through a strategies approach.

For the past five years I have been working with schools in Australia on a project funded by the federal government and two states to develop an organised approach to mental computation from the basic addition and subtraction facts to decimals, fractions and percents. The result is a set of six modules. I will briefly describe the background and content of this material and explain how participants can obtain a free CD of the material.

Kari Hag: Peer assessment in mathematics at NTNU

Maugesten and Lauvås (2005) reported on spectacular improvements in class performance after the introduction of a peer-assessment methodology in a class of approximately 100 students at the Østfold University College. We wanted to investigate whether similar gains could be made at the university level. In a pilot study during the Spring Term 2005, peer-assessment was tried out in one section (consisting of student teachers) of the course Multilinear Analysis.

We collected student opinions with two surveys, one early on in the course and the second right after the end of the course. The students generally thought that the peer-assessment was a good idea, and that it should be used in at least one class. They thought that working in groups was fun and good for learning to communicate mathematics. Somewhat surprisingly, quite many students were not convinced that getting peer-feedback improved the quality of their writing.

Jari Lakka: Building addition and subtraction strategies in early primary school mathematics

1st and 2nd grade pupils thinking strategies in addition and subtraction tasks are researched in this multiple case study. An approach is phenomenographical. I interviewed 6 first graders and 11 second graders three times through a school year 2003-2004. I found four categories in counting. 1st category consists of those undeveloped and inadequate strategies, which some school starters have. They can count only with small numbers under five. 2nd category is that counting with number words and double counting. It was found to be a very basic strategy and some pupils use it permanently. 3rd category is “self learned strategies” based on remembering. But this is efficient only with numbers under 20. The fourth and the most efficient strategy is that strategy based on partitioning a number and counting via ten.

Abstracts of workshops

May Renate Settemsdal, Toril Sivertsen, and Ingvill Merete Stedøy:

Math clubs – a door opener to mathematics

At the Norwegian Center for Mathematics Education we have an ongoing project developing math clubs and looking into several aspects of the effects of participation among the children and youngsters. Two master studies with different focuses on the math clubs will be presented briefly in the workshop.

The math clubs have been designed for students at the ages 5, 9 and 14 – 15 years old. In the workshop we will focus on the target groups for the master studies, 5 year olds and 14 – 15 year olds. For the presentation we will set the stage of the math clubs, the theory behind the studies, as well as the main results. We will show pictures and give examples of the activities that were designed for the club. The participants will take part in the activities, and we will challenge them to try to characterize the tasks and challenges the children and youngsters are given.

Simon Goodchild, Heidi S. Måsøval, and Barbara Jaworski:

Workshop on classroom research: Learning from students' talk in the mathematics classroom

Aims

- To demonstrate that classroom episodes can be interpreted in a variety of ways, each with a validity that arises from whatever theoretical perspective (or set of beliefs, values and assumptions) held by the interpreter.
- To demonstrate that 'we' learn about these multiple perspectives by listening to each other, and from questioning the beliefs, values, etc. upon which interpretations are articulated.
- To demonstrate the role of theory in making interpretations and the role of empirical evidence in the development of theory.

Outline programme:

Part 1: 14.45-15.45 Introduction to the Workshop: Simon Goodchild
Presentation of analysis of classroom episode 1: Heidi S. Måsøval
Presentation of analysis of classroom episode 2: Barbara Jaworski

Break: 15.45-16.15

Part 2: 16.15-17.15 Introduction of activity for group activity: Simon Goodchild
Group activity – working on transcripts of episodes with two 14-15 year old students.
17.15-18.00 Feedback from group activity including analysis by Simon.
Plenary discussion in which all participants have the opportunity to question and respond to issues arising from both parts of the workshop.

Social programme

Friday 2nd September at 19.00: Immediately after the lecture by Mogens Niss there will be a welcome reception in the hall outside the main lecture room. A drink and some snacks will be served.

Sunday 4th September from 15.00 to 19.00: Buses will leave from the Royal Garden Hotel right after the short communication and workshop session and take us to the open air museum at Sverresborg, a short drive from the city centre. The museum has a large collection of old buildings from Trondheim and the surrounding area. We will have a guided tour and visit two old churches and a couple of farm houses, all from different parts of the area around Trondheim. After the tour we will have coffee/tea and a bun in the old inn, Tavern, located on the museum grounds. Incidentally, this inn originally was located on the same site as the Royal Garden Hotel today stands. Before returning to the hotel the buses will drive up to Bymarka, one of the recreational areas for the people in Trondheim. Here we will have the possibility for a short hike, the weather permitting.

Monday 5th September at 20.00: The conference dinner will take place in the hotel restaurant, Cicignon. We will start with an aperitif in the hall outside the restaurant at eight o'clock. After the dinner there will be music and the possibility for using the dance floor in the restaurant. This dinner is included in the registration fee for all participants, whether staying at the hotel or not.

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