Øresundsdagen 3

Conference on introductory courses in university mathematics,
2 Nov 2022, Lund University

09:30 - 10:00	**Registration**
10:00 - 10:10	**Welcome**
	Part 1: Keynote talks
10:10 - 11:00	Ola Helenius, Gothenburg University, Sweden. *The many meanings of mathematical concepts.*
11:10 - 12:00	Burkhard Alpers, Aalen University, Germany. *My Way into and through the Didactics of Engineering Mathematics.* (via Zoom)
12:00 - 13:00	**Lunch**
	Part 2: Contributed talks
13:00 - 13:10	**Introductory remarks to the contributed talks session**
13:10 - 13:30	Tracy Craig, University of Twente, The Netherlands. *Closing the gap between scholarship and practice.*
13:30 - 13:50	Iver Mølgaard Ottosen, DTU, Denmark. *The challenges of basing a full mathematical course entirely on realistic examples.*
13:50 - 14:10	Mats Brunström, Maria Fahlgren, Mirela Vinerean-Bernhoff, Yosief Wondmagegne, Karlstad University, Sweden. *Digital tools to support first year students' mathematical thinking.*
14:10 - 14:30	Niclas Larson, University of Agder, Norway. *STACK-tests in Mathematics 1.*
14:30 - 15:00	**Coffee and cakes**
15:00 - 15:20	Frode Rønning, NTNU, Norway. *A program driven approach to mathematics in engineering education.*
15:20 - 15:40	Laura Fainsilber, Linnea Hietala, Chalmers/GU. *Group assignments for contact and communication in distance education.*
15:40 - 16:00	Samuel Bengmark, Chalmers/GU, Sweden. *PREP - Pragmatic Research on Educational Practice.*
	Part 3: Panel discussion
16:10 - 17:00	Panel discussion (Alpers, Bengmark, Rønning, Linda Marie Ahl). *Based on the talks, is it fair to say that teaching practice and research in didactics support each other? How can we strengthen this link?*
17:00 - 17:10	Closing remarks.
18:00 -	Informal dinner

Conference venue: Edens hörsal, Allhelgona kyrkogata 14, Lund. (link to Google maps)
Conference website: https://www.maths.lu.se/index.php?id=258877
Informal dinner: Kulturens restaurang (https://www.kulturen.com/kulturensrestaurang/)
Registration (until October 15): https://forms.gle/1c4u5ftTP69v7KGi9

Abstracts

Keynote talks (in order of presentation)

Ola Helenius, Gothenburg University, Sweden
The many meanings of mathematical concepts

One of the tasks of mathematics education research is to explain what constitutes mathematical thinking. This question becomes didactical rather than philosophical when it is also considered why mathematics is so easy for some and so hard for some, and how the teaching of mathematics influences students' mathematical thinking. In this talk I will consider the role of teaching in giving meaning to mathematical concepts by taking a look at mathematical conceptualisation in a way that transcends educational levels. In fact, I will describe that there are three ways to give meaning to mathematical concepts: through classes of situations, like when division is understood through equal sharing of objects; through iconic schematic imagery, like when fraction is understood through circle sector arrangements; and as relations in symbol systems, like when a/b is understood as a symbol c such that cb=a. In school mathematics, the two former meaning making principles dominates, and symbol systems are rather treated like a type of labelling of the patterns that can be discerned in the situation and iconic imagery. Moreover, the same concept is often given several related but slightly different meanings by being connected to different but related classes of situations or iconic imagery. This constitutes mathematical polysemy: when one concept has several different but related meanings.

I will also show that mathematical concepts typically introduced in university mathematics tend to be polysemic too. Taking this property of mathematical concepts seriously may be a fruitful way of making students' transition into formal mathematical thinking easier.

Burkhard Alpers, Aalen University, Germany.
My Way into and through the Didactics of Engineering Mathematics.

In my presentation I will reflect on the conditions that lead me into thinking about didactical issues regarding the mathematical education of engineers and about developmental stages of getting deeper into mathematics education research, projects and permanent adaptation of my own teaching. Moreover, the form and role of exchange with colleagues and researchers is also considered. It is the main intention of the talk to give ideas and possibly inspirations of how to get involved in the didactics of engineering mathematics.

Contributed talks (in order of presentation)

Tracy Craig, University of Twente, the Netherlands.
Closing the gap between scholarship and practice.

This presentation outlines a new course being planned at the University of Twente which will close the gap between the scholarship of teaching and learning and on-the-ground educational practice. Using aspects of the challenge-based learning framework, maths/engineering students will identify an educational challenge, carry out a literature review and produce an evidence-based product of concrete practical use to a stakeholder, a lecturer of mathematics. The students will become familiar with educational theory and literature relevant to their challenge and will learn how to engage with educational academic literature. Teachers of mathematics, themselves not scholars of teaching and learning and without the time to carry out deep reading of the relevant literature, will gain substantively from students' products. We hope to pilot this course soon.

Iver Mølgaard Ottosen, DTU, Denmark.
The challenges of basing a full mathematics course entirely on realistic examples.

In this joint effort with Per Skafte Hansen (who was the primus motor of this project), we undertook to create and teach a 15 ECTS points mathematics course (calculus, differential

equations and basic statistics) almost entirely based on realistic examples, i.e., problems extracted from engineering practice, supplemented where necessary with equations from the natural and social sciences, as well as economics and various crafts. This endeavour generated a 6-volume set of highly structured notes and exercises, organized in learning objects and prepared for the further development of e.g. e-learning modules comprising the whole course or cherry-picking relevant parts. To the best of our knowledge, the course is unique in its kind, so we try to identify the challenges posed by such an undertaking and to explain how we met them.

Mats Brunström, **Maria Fahlgren**, **Mirela Vinerean-Bernhoff**, **Yosief Wondmagegne**, Karlstad University, Sweden.
Digital tools to support first year students' mathematical thinking.

In this presentation, we will report on an ongoing research project at Karlstad University in Sweden, with the aim to enhance first-year engineering students' engagement in and conceptual understanding of Calculus content. The focus is on the design of a digitized task environment utilizing a combination of two types of technology – a dynamic mathematics software (GeoGebra) and a computer-aided assessment system (Möbius). So far, two computer-based activities, in the form of task sequences focusing on function understanding, have been developed and trialed.

Niclas Larson, University of Agder, Norway.
STACK-tests in Mathematics 1.

On the engineering education at the University of Agder, campus Grimstad, the form of the examination in the first mathematics course changed dramatically in the autumn semester 2022. Earlier, this course was examined by a classical written exam at the end of the semester. A negative consequence of that high-stake exam, was that during the semester students often focused what was told to be relevant for the exam, rather than what mathematics is useful for their education. The new model consists to 60 % of four written tests spread over the semester. These tests are distributed and answered in STACK, which also automatically evaluates the students' answers. The tests are taken at campus under supervision. Each test can be taken multiple times, and the best results will count. Two purposes of this model are that multiple and smaller tests will be perceived as less stressful by the students, and that the students will learn from the tests, which will enable the lecturer to teach more freely. The model is currently evaluated by mathematics education researchers, both with a quantitative and a qualitative approach. In addition, for next year a slightly modified model is planned to be applied in the first calculus course at campus Kristiansand, University of Agder. Then, the tests will be mandatory, and a pass grade will be necessary to qualify for the final exam. The purpose with such a model is that the students must be active already in the beginning of the semester, rather than delay intense work until the weeks before the final exam. From a mathematics education research view, this will also make it possible to compare the two models, from Grimstad and Kristiansand.

Frode Rønning, NTNU, Norway.
A Programme Driven Approach to Mathematics in Engineering Education.

In this talk I will report from a project where future engineers are trained to use mathematical models and concepts based on the principle of contextual learning and a programme driven approach, with educators from mathematics and applied fields working together. A crucial point is to design the teaching of mathematics in a way that the students find the mathematical topics to be relevant for their particular engineering field. For this to happen, engagement both from teachers in mathematics and teachers in the engineering subjects is required.

In the talk, I will present examples and experiences mainly from electrical engineering, which is the field that we have worked most extensively with. I will also discuss challenges and possible solutions when scaling up from working with 1-2 engineering programmes to a wide range of programmes.

Laura Fainsilber, **Linnea Hietala**, Chalmers/GU, Sweden.
Group assignments for contact, communication and understanding in an online mathematics course.

In 2021, we designed and used new group assignments in the first math course of online version of the Foundation Year (Swedish: Basåret.) Besides learning the mathematical content and introducing mathematical software, the goals of the group assignments were:

- To give students an opportunity to meet each other
- To train cooperation and communication in mathematics
- To confront student with open-ended questions
- To widen student's view of how to study mathematics

Students were randomly assigned to a new group of 4 or 5 each week, and asked to take a specific role in the discussion (e.g. discussion facilitator, illustrator, scribe, connection maker). Both the format, the formulation of assignments and the use of roles for group collaboration are inspired by research in Mathematics Education. We collected the assignments that were turned in, peer response and a student evaluation, as material for further development and research. In our talk, we will discuss design, benefits and challenges of using this type of group assignments.

Samuel Bengmark, Chalmers/GU, Sweden.
PREP — Pragmatic Research on Educational Practice.

Ambitious educators try different forms of interventions in their teaching to see what the effects are. However, they often do not have enough time, or data, to meet the requirement of regular educational research. In this talk, we describe a program for studying and improving teaching practices that uses the activities that educators often already do when developing and evaluating courses and assessing students' knowledge. We call this Pragmatic Research on Educational Practice, or PREP for short. PREP aims to inspire educators to support each other in the process and share the knowledge they gain to add value to the teaching community and themselves without adding too much to their workload. (A longer version of this abstract can be found by clicking here.)