

TSG Agenda

TSG 45: Mathematics for non-specialist/mathematics as a service subject at tertiary level

Class: A

Session 1

1. Time: 14:30—15:00

Title of the Paper: MATHEMATICS AS A SERVICE SUBJECT: HISTORICAL DEVELOPMENT AND MAJOR PLAYERS FROM A EUROPEAN PERSPECTIVE

Author(s): Burkhard Alpers

Institution(s) (to school/department/research center) and Country/Region: Aalen University, Germany

Short abstract of the paper (20 lines maximum):

Mathematics education at the tertiary level has quite different goals depending on the kind of study course where it takes place. Situated in application study courses, mathematics education serves the purpose to enable students to acquire the mathematical competencies required in the study course as well as in the corresponding professional practice and is hence called “service mathematics”. Such application study courses comprise natural sciences (like physics, chemistry, biology), engineering (mechanical, electrical, civil), economics/business as well as other arts and sciences where predominantly statistical methods are used (like medicine, psychology, pedagogics). This contribution addresses the didactics of service mathematics. It outlines the historical development starting with a study conference of the International Commission for Mathematics Instruction (ICMI) on this topic in 1987. The major subsequent ICMI activities are discussed and the development as a research field within the scientific community is sketched. Furthermore, the activities of professional societies directed at education of professionals are presented. The author has a European perspective.

2. Time: 15:00—15:30

Title of the Paper: CONCEPTUALIZING SERVICE AND GENERAL EDUCATION MATHEMATICS

Author(s): Wes Maciejewski

Institution(s) (to school/department/research center) and Country/Region:
San José State University, USA

Short abstract of the paper (20 lines maximum):

Service and General Education (SGE) mathematics courses constitute the majority of a mathematics department's course offerings in the United States of America, Canada, and elsewhere. The students taking these courses are necessarily not mathematics majors, though the instructors are within mathematics departments. This creates numerous tensions—are SGE students somehow different than mathematics majors? Should they all learn the same mathematics? Who should teach these students? In an effort to gain traction on these questions, and to bring clarity to SGE mathematics education more broadly, I present a model that positions the institution as the key agent in SGE mathematics. I argue that this prominence of the institution is what distinguishes SGE mathematics from other mathematics educational settings.

3. Time: 15:30—16:00

Title of the Paper: A PRACTICE REPORT ON MATHEMATICAL MODELLING EDUCATION FOR HUMANITIES AND SOCIAL SCIENCES STUDENTS

Author(s): Mitsuru Kawazoe

Institution(s) (to school/department/research center) and Country/Region:
Osaka Prefecture University, Japan

Short abstract of the paper (20 lines maximum):

This is a practice report on our teaching practice of mathematical modelling education for humanities and social sciences students at our university. Our practice was initiated in

order to respond to a request from departments in social sciences and psychology, and also to respond to the growing social demand on such education in Japan. It has been a challenging task because many of those students are not good at mathematics and do not like mathematics. In this report, we will reflect on our nine-years practice from the phase of preparation of the course to the present, and report some findings from our teaching practice.

4. Time: 16:00—16:30

Title of the Paper: FLEXIBLE CONTENT, INSTRUCTION, AND ASSESSMENT IN A UNIVERSITY-LEVEL QUANTITATIVE REASONING COURSE

Author(s): **Deependra Budhathoki**, Gregory D. Foley, Stephen N. Shadik

Institution(s) (to school/department/research center) and Country/Region:
Ohio University, USA

Short abstract of the paper (20 lines maximum):

In this case study, we investigate the initial implementation of an entry-level university quantitative reasoning course, the instructor's motives and actions, and how the students responded to the course. The participants were the course instructor and students. Data included course artifacts, class observations, an instructor interview, and students' written reflections. Because this was a new course—and to adapt to student needs—the instructor was flexible in designing and enacting the course content, instruction, and assessment. The students generally benefited from this approach and enjoyed the course.

Session 2

1. Time: 19:30—20:00

Title of the Paper: A SMALL-SCALE IMPLEMENTATION OF INQUIRY-BASED TEACHING IN A SINGLE-VARIABLE CALCULUS COURSE FOR FIRST-YEAR ENGINEERING STUDENTS

Author(s): **Olov Viirman**, Irina Pettersson

Institution(s) (to school/department/research center) and Country/Region:

Uppsala University, Sweden, University of Gävle, Sweden

Short abstract of the paper (20 lines maximum):

We report from the first iteration of a small-scale project introducing elements of inquiry-oriented education in a first-year engineering Calculus course. In some of the exercise sessions we introduced problem solving in groups, using tasks designed to provide alternative viewpoints on central topics of the course, for example limits, differentiation and integration, and containing elements of modelling and numerical methods. The theoretical perspective underlying the design was commognitive theory. We also report some observations made during the first iteration of the project, and how these will feed into the second iteration currently being planned.

2. Time: 20:00–20:30

Title of the Paper: SOMETIMES MATHEMATICS IS DIFFERENT IN ELECTRICAL ENGINEERING

Author(s): **Jana Peters**, Reinhard Hochmuth

Institution(s) (to school/department/research center) and Country/Region

Leibniz University Hannover, Germany

Short abstract of the paper (20 lines maximum):

In this contribution we will present an ongoing research project on mathematical practices in electrical engineering. Using ATD, we take an institutional point of view on mathematical practices and focus on the mathematical content. This enables us to conceptualise two ideal type mathematical discourses corresponding to different epistemological constitutions of mathematical knowledge in higher mathematics courses and in advanced courses in electrical engineering respectively. We will enrich our presentation with short vignettes of our latest research results to illustrate the kind of insights that the institutional point of view enables us to gain. Finally, if we have arrived on the basis of a specific understanding of our statement that mathematics is sometimes different in electrical engineering, we derive suggestions for the design of teaching and

feedback to students which are justified due to the theoretical embedding and further empirical analyses results.

3. Time: 20:30—21:00

Title of the Paper: WHICH MATHEMATICS COMPETENCES ARE RELEVANT FOR ENGINEERING EDUCATION? - A MIXED METHODS STUDY

Author(s): Malte Lehmann

Institution(s) (to school/department/research center) and Country/Region:
Humboldt-Universität Berlin, Germany

Short abstract of the paper (20 lines maximum):

Students' mathematical knowledge at the beginning of their engineering studies have rarely been an objective of empirical research. Mathematical knowledge becomes apparent when dealing with physical problems. For describing the solution processes of students, different frameworks exist. One of which, the Epistemic Games, enables a fine-grain analysis of the mathematical and physical resources used. The aim of this mixed-methods study is to explain the relationship between mathematical and physical knowledge, and to investigate how the solution processes of engineering students in their first year can be described by using Epistemic Games. 19 engineering students were examined during the first year of their studies while being immersed in physical problem solving. The results show that mathematics knowledge is a predictor for physical knowledge at the end of the first year, and reveal that students change their EG use to more schematic approaches. The schematic use of mathematics in mathematics lectures is reflected in a schematic application in students' solving of physical problems. Thus, focus on conceptual understanding is needed

Session 3

1. Time: 21:30—22:00

Title of the Paper: THE ATTITUDES OF LECTURERS AND STUDENTS TOWARDS PUZZLE-BASED LEARNING: THE CASE OF DIFFERENTIAL EQUATIONS

Author(s): **Farzad Radmehr** (1,2), Faezeh Rezvanifard (2), Michael Drake (3)

Institution(s) (to school/department/research center) and Country/Region:

(1) University of Agder, Norway, (2) Ferdowsi University of Mashhad, Iran, (3) Victoria University of Wellington, New Zealand

Short abstract of the paper (20 lines maximum):

Solving real-world mathematical problems is a difficult task for many undergraduate students. Previous studies related to Puzzle-Based Learning (PzBL) have reported that this approach is effective to improve students' problem-solving skills. A few studies have explored the possibilities of using PzBL in the teaching and learning of mathematics, especially in calculus, however, a literature search revealed no examples of studies about using PzBL in the teaching and learning of Differential Equations (DEs). In this study, attitudes of 134 undergraduate engineering students and 17 mathematics lecturers towards PzBL in relation to the teaching and learning of DEs are explored using a questionnaire and semi-structured interviews. The findings indicated that many engineering students and mathematics lecturers had positive attitudes towards using PzBL in teaching and learning of DEs as they believed puzzle-problems are enjoyable and entertaining activities; and improve mathematical understanding, problem-solving, and thinking skills.

2. Time: 22:00—22:30

Title of the Paper: CAN WE MAKE MATHEMATICS INTERESTING FOR ENGINEERING STUDENTS? MODELLING TASKS IN AN ORDINARY DIFFERENTIAL EQUATIONS COURSE

Author(s): Svitlana Rogovchenko

Institution(s) (to school/department/research center) and Country/Region

University of Agder, Norway

Short abstract of the paper (20 lines maximum):

A new teaching unit called Modelling Project was developed in an Ordinary Differential Equations course for engineering students in order to motivate their interest in conceptual understanding of mathematics and to underline the relevance of mathematics to engineering studies. The teaching unit was introduced as an assessed piece of the regular coursework. Students studied in pairs and submitted project reports. They were asked to use a Computer Algebra System of their choice, Maple or MATLAB, as a tool for the analysis of the models. The data collected in this study include students project reports, questionnaires, and teachers' reflections. Activity Theory was used for the analysis of the contradictions exhibited in the activity such as contradictions between teaching goals and students' goals, between the requirement to use CAS and students' ability to use it.

3. Time: 22:30—23:00

Title of the Paper: TEACHING MATERIALS ON CALCULUS AS SEEN FROM THE APPLICATION TO ENGINEERING

Author(s): **Satoru Takagi**, Kesayoshi Hadano, Sei-ichi Yamaguchi

Institution(s) (to school/department/research center) and Country/Region:
Waseda University, Kyushu Sangyo University, Rikkyo University, Japan

Short abstract of the paper (20 lines maximum):

The authors are to publish the teaching materials on calculus including multi-variable functions for first course undergraduate students in science and engineering fields. The materials, different from many common-place textbooks, first of all introduce the topics encountered in engineering and then explain the mathematical aspects. This style aims to make readers smoothly understand mathematical concept by extracting their interests and by offering topics which appeal to intuition.

Note:

Class A:

- Session 1: 14:30-16:30 Beijing time, July 13th
- Session 2: 19:30-21:00 Beijing time, July 14th
- Session 3: 21:30-23:00 Beijing time, July 17th