INTRODUCTION

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The articles published in this issue are based on the presentations in 35th Annual research symposium of Finnish Mathematics and Science Education Research Association. The symposium was organized in University of Tampere November 8th–9th 2018. The theme of the symposium was "The conceptual understanding of mathematics and science and its meaning in versatile learning environments" (Matematiikan ja luonnontieteiden käsitteellinen osaaminen ja sen merkitys monipuolisissa oppimisympäristöissä). The concept learning and conceptual understanding are among the most important aspects of mathematics and science education. Therefore, it is interesting to explore how they are or can be supported in various learning environments and what novel ways are possible in new and developing learning environments. The theme was addressed in the keynote lectures.

Professor Harry Silfverberg discussed the conceptual knowledge of mathematics as a target of research. He gave an overall view of the meaning of mathematics' conceptual knowledge and the development of this research field both internationally and nationally. The research of mathematics' conceptual knowledge could target the concept learning or formation, conceptual development including the concepts and concept structures, conceptual change, conceptions and beliefs and understanding and mathematical thinking. Further, these viewpoints can be examined in different domains of mathematics, for instance in geometry, probability, and functions. Professor Silfverberg gave a solid view of the importance of the conceptual knowledge and understanding in the research field of mathematics (and science) education.

Docent Maija Nousiainen discussed how physics conceptual knowledge and knowledge structures can be argued, justified, and presented in didactical physics. Her presentation gave a picture of the research implemented in the field of didactical physics, and specifically, how pre-service physics teacher education is based on and further develop through research. Docent Nousiainen also discussed different research-based graphical tools that are applied in physics

teacher education in order to support the pre-service teachers in knowledge organization and in learning to argue and justify the knowledge in solid and coherent ways. Altogether, she illustrated practical research-based approaches to enhance the conceptual knowledge and understanding of pre-service physics teachers.

In addition to invited keynote lectures, there was 38 presentations concerning various aspects of mathematics and science education research. These 38 presentations had altogether 74 individual authors or co-authors, and there were eight papers including an international author team. Besides presenters and participants, about 50 prospective mathematics and science teachers participated in the parallel sessions in order to hear and learn about the latest research-based knowledge in the field and about doing research in mathematics and science education.

Last year 2019 FMSERA Journal was classified at rate-level 1 by Finnish Publication Forum. Therefore, this is the first published issue with level 1 rating, which is a sign of a standard peer-review process and editorial board consisting scientific experts of the field. For the FMSERA, it is important to have association's own solid level publication, and the efforts that the boards of FMSERA and FMSERA Journal and some other active members of the FMSERA have put to this is acknowledged. We received nine manuscripts to be considered for publication. The process continued in case of six manuscript after first review round and four of these were completed following reviewers' requirements and suggestions. We would like to thank all submitters and reviewers. Next, we shortly introduce the articles accepted to this issue.

Espinoza, Pikkarainen, Viiri, Araya, Caballero, Jimenez, and Gormaz explore in their article *Analyzing teacher talk using topics inferred from unsupervised modeling from textbooks* the possibilities of machine learning in examination of teaching. By applying LDA model, they examine the content-specific concepts and words on teacher talk, such as *battery* and *electric current* (DC-circuits). On the other hand, they have also examined some action-related words, such as *however, for example* (explaining), *solution, equation,* and *sum* (calculation). Examining lessons through this teacher talk analysis makes a comparison of different content topics and different lessons of the same topic possible, also the temporal analyses illustrate the structure and emphases of the lessons.

In the article *Conceptual network of teachers' talk: Automatic analysis and quantitative measures* Caballero, Pikkarainen, Araya, Viiri, and Espinoza present a case study, which explores several aspects related to research methodology and instruction. From the methodological perspective, they applied automated speech recognition (ASR) to transcribe teachers' talk, then they applied text data mining (TDM) and finally created an automatic concept network of teachers' talk and calculated some network measures for the concept networks. All of these are rather new

methods in the field of science education research. From instructional perspective, they compare the concept networks of teachers' talk to learning gains of students. Although the results are exploratory, it raises interesting questions of the fruitful emphasis of teaching.

Rinneheimo and Joutsenlahti report the implementation of languaging exercises in an engineering mathematics course ´Differential Calculus´ in their article *Towards better comprehension of the theory by enhancing languaging exercises in engineering mathematics course differential calculus*. Mathematical exercises are typically seen as expressible by symbols and expressions. Languaging exercises, however, are expressed by natural language or by pictures, or by a combination of these two. Studies conducted among university students have shown that the use of languaging exercises can develop students' mathematical understanding. Rinneheimo and Joutsenlahti demonstrate how the languaging exercises were utilised to clarify and deepen the learning of the theory of differential calculus. The findings indicate that the students who mastered languaging exercises got better exam results in the exercises related to understanding the theory than the students who did not master languaging exercises.

In the article *Individual teaching and self-assessment as part of the performance of the university mathematics course* Erämaa, Kaarakka and Elomaa describe a development research project in mathematics education at university level. The need for differentiation and support of e-learning environments have moved the practical arrangements of university courses towards integrative learning and teaching. Self-evaluation is one of the working life skills that reinforces the ability to learn. The writers implemented a research project in mathematics teaching at Tampere University of Technology, combining the above. The article describes the study and its initial positive results.

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