# ERME column

regularly presented by Jason Cooper and Frode Rønning

In this issue, with a contribution by Shai Olsher

## CERME Thematic Working Groups

The European Society for Research in Mathematics Education (ERME) holds a bi-yearly conference (CERME), in which research is presented and discussed in Working Groups (TWG). We continue the initiative of introducing the working groups, which we began in the September 2017 issue, focusing on ways in which European research in the field of mathematics education may be interesting or relevant for research mathematicians. Our aim is to extend the ERME community with new participants, who may benefit from hearing about research methods and findings and who may contribute to future CERMEs.

## Introducing CERME Thematic Working Group 22 – Curricular Resources and Task Design in Mathematics Education

Group leader: Shai Olsher

### *Group rationale*

Curricular resources and task design carries within its scope a two-fold connected perspective. At the macro level, teachers, lecturers, and students work with mathematics curriculum resources, both digital and traditional, inside and outside the lecture hall or the classroom. Individually or collectively, teachers and instructors select, (re)design, modify, and interact with such resources for lesson preparation, student assessment, and the planning of their courses. These resources (e.g., educative curriculum materials) are the focus of professional development sessions, where mathematics teachers, often with education researchers, design and transform curriculum resources, including blended materials, and in the process develop design capacity and valuable knowledge for teaching. At the micro-level, curriculum resources contain mostly tasks derived from textbooks or other sources. The representation of these tasks in resources, their sequencing, and the lecturers' and teachers' actions during their enactment can limit or broaden the cognitive demand the tasks impose and affect students' views of the subject matter. Thus, they can influence the opportunities afforded to students to make mathematical connections and to develop mathematical concepts, skills, or habits of mind. The literature indicates that tasks play a key role in effective teaching. There has been an upsurge in publications on various aspects of task design (e.g., task features that can help generate certain forms of mathematical activity); methods of task analysis (e.g., analyses of the learning affordances of certain kinds of tasks); and principles for task implementation in conventional and digital learning environments (e.g., factors affecting the fidelity of implementation of tasks in the classroom). Students can also be involved in task design activities to foster their reflections about what they know, understand, and do.

### *TWG history*

The Thematic Working Group 22 – Curricular Resources and Task Design in Mathematics Education was launched at CERME 10 (2017) in recognition of the growing area of research in the field of curriculum resources, their process of design and implementation by various stakeholders, and the specific design of mathematical tasks, by both teachers acting as designers of their own teaching as well as in curricular resources such as textbooks. As presented in the rationale, this field shares approaches, methods, and research topics found in other areas of mathematics education research (e.g., design and use of technological platforms, professional development of teachers), it has its own distinctiveness, and dual focus of the TWG, on both the macro level of curriculum research and micro-processes of task design and implementation research provides also a unique opportunity to connect and discuss the mutual influence of different units of analysis. Historically, only a small number of lecturers involved in tertiary education participated in this focused thematic working group.

### *TWG topics*

The following section provides several exemplary issues which emerged in the TWG "Curricular Resources and Task Design in Mathematics Education" during the 2022 ERME conference. These topics include research on teachers' and students' interactions

with curriculum materials, theoretical foundations and methodologies of task analysis, the collaboration between teachers, between teachers and researchers, and students for designing tasks and resources and for analyzing their implementation, and affordances and constraints of digital and conventional tasks and resources.

Concerning students' interactions with curriculum materials, one central question is about the affordances of digital curriculum resources and their influence on the learning process. This question was addressed by several studies using students' reflections about the study content and learning process, which is regarded as an important aspect of learning in K-12, but also in university-level courses. In addition, studies suggested finer definitions and characterizations for given student interactions that could manifest through concrete design features of mathematical tasks such as problem posing and working backward.

Another aspect that was highlighted by studies was the interrelatedness of curriculum resources with the social and cultural context in which they are developed and used. These studies stressed the contextual and cultural influences on teachers' and students' interactions with curriculum resources, raising the issue of how to read and interpret studies about curriculum resources from different social and cultural contexts, and suggesting that results from one context cannot easily be transferred to another. This issue is manifested also in university teaching, which embodies unique contextual influences, but also common phenomena such as the stability and resistance to change among practitioners.

Regarding the analysis of the selection and characterization of tasks by teachers, one assumption was that understanding task perceptions of prospective elementary teachers could help predict their eventual modification and appropriation for classroom use, which can affect teachers' practice. These studies raised the issue of "good" mathematical tasks – good for what purpose? A study of the collaborative task characterization by teachers as suitable for introduction or enrichment and presented several dilemmas. Among the results was the observation that introductory tasks should have an easy entry level and not require pre-knowledge of the upcoming concept, while an enrichment task should require relatively deep conceptual pre-knowledge. Teachers' verbalization of task characteristics was one outcome, but not all tasks met all criteria. A relevant question to university level lecturers is what kind of discourse and analysis is taking place when it comes to tasks in university courses, and do they see a potential benefit in such discussions and studies?

Concerning the use of carefully designed curriculum materials to support the implementation of particular learning goals and enhance mathematical competences, one question is how to design tasks and items so as to provide students with opportunities to make mathematical connections and develop mathematical concepts, skills, and habits of mind. The characteristics of task design can influence the processes that characterize students' interaction with the tasks or items themselves, and among these, studies focused on how the design of specific tasks and resources influences students' reading processes. The interrelation between enhancing efficient reading and enhancing students' comprehension and reasoning, the role played by metacognitive processes in guiding students' reading processes when interacting with tasks with certain characteristics, and the effect of students' age were the focus of different studies. An interesting common facet was methodological: the use of eye-tracking technology to investigate students' reading processes when interacting with the designed tasks and resources.

Several issues related to the design of learning environments, in particular, when the focus of the design is the role of tangible tools or physical objects, considered as products of digital design, or as tools to be combined with digital ones. Studies emphasized the role played by the teacher's orchestration in combining the use of digital and tangible tools, noting that teachers should make the connection between digital and tangible tools clearer if they want students to work effectively with a combination of these tools. In addition, viewing teachers' learning when they make, share, and use manipulatives, studies suggest communities of practice as a framework for understanding teachers' learning of digital fabrication for mathematics education.

Many of the research topics seem a priori relevant for tertiary education, yet it is difficult to even imagine what they would look like there (e.g., what kinds of digital resources are relevant for a proof-oriented mathematics course). While some results that focus on the analysis of digital resources in undergraduate Linear Algebra courses are to be presented at CERME 13, this suggests possible avenues for an emerging field of research.

*TWG future*

With the growing connectivity of online resources, one future focus of the TWG is expected to be on expanding the populations that interact in new ways with curricular resources (e.g., student's participation in the curricular design process). Yet while other TWG's could share a common interest in curricular design in the form of digital platforms, or task design and implementation as means to focus on teachers' knowledge or professional development, TWG 22 participants have been traditionally focused on a curriculum-centered perspective, which allows gaining insight on the curricular resources and the different agents that interact with them. Curriculum resources are part of every level of mathematics education, from preschool to university courses, and as such TWG 22 warmly welcomes participation and contributions from the wider mathematics community. Specifically, mathematicians who are interested in changing their use of resources and/or researching the effect of such change may find CERME's TWG 22 an interesting venue for learning and collaborating.

Shai Olsher is a senior lecturer at the Mathematics Education Research and Innovation Center and the Department of Mathematics Education at the University of Haifa. His research combines three strands: mathematics education, digital technologies, and curriculum resources design and implementation. Shai's work is not reduced to studying existing technologies but also includes the design, development and implementation of innovative technologies in learning, teaching, and assessment in mathematics.

olshers@edu.haifa.ac.il