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Introduction to the papers of TWG20: mathematics teacher knowledge, beliefs, and identity

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Rationale

For TWG 20, 27 papers and 5 posters have been presented. Due to the high number of papers, the TWG20 was divided into two subgroups, A and B. Although the proposals were expected to embrace three intertwined domains, similarly to what occurred previously (CERME10), the focus of the presented papers at CERME11 was mainly on teachers' knowledge. The topic of teachers' beliefs was addressed in several papers, including studies on teachers' conceptions and student teachers' collective orientations, while only one paper focused explicitly on the topic of teachers' identity – also a tendency from previous conferences. Several research by PhD students were discussed.

Main topics

Teacher knowledge

When TWG 20 first started as a new TWG in CERME9 (2011), most of the discussion was evolving around teacher knowledge models, how they emerged, developed and how they explain teacher knowledge and partly around their comparison. In TWG 20 during CERME11, compared to previous conferences, models were given less attention. Looking back and reflecting on discussions during CERME11, the group has moved from discussing on teacher knowledge models to mostly using models for further exploration of teacher knowledge in various contexts and on different topics (Piñeiro, Castro-Rodríguez, & Castro; Spratte, Euhus, & Kalinowski; Aguilar-González & Rodríguez-Muñiz, in this volume). There has been discussion of how different stakeholders in mathematics education see teacher knowledge. Jacinto and Jakobsen's paper focused on teachers' perception on horizon content knowledge while examining teacher education programs in Malawi. Similarly, Dahlgren, Mosvold, and Hoover studied teacher educators' understanding of mathematical knowledge for teaching. In this paper authors used MKT model (Ball, Thames & Phelps, 2008) primarily to examine teacher educators' views and not their knowledge of teaching mathematics. During the discussions, conceptualizing knowledge from different perspectives gained attention: e.g. Crisan's paper focused on advanced mathematics knowledge of teachers and ways to support teachers in that respect. Similarly, Pehlivan and Aslan-Tutak focused on preservice secondary mathematics teacher knowledge of mathematical representation translations without

taking any teacher knowledge model as the theoretical framework but focusing on participants' knowledge of mathematics. When carrying out research on teacher knowledge, models of the knowledge of mathematics teachers can provide a structure for research. However, as there is a variety of different models, the potential benefits from the structuring role of teacher knowledge models can only be drawn on if the key question is answered why a certain teacher knowledge model is chosen/used and what can be gained from using this specific model. The features of the teacher knowledge models argued respond to specific needs of describing and explain specific phenomena: e.g. integration of beliefs in the models by Carrillo et al. (2018) and Kuntze (2012). The MTSK model (Carrillo et al., 2018) was used in nine papers focusing various perspectives of mathematics teaching such as analysis of development of tasks, university level teaching, secondary school level teaching and policy analysis. Another model, the Knowledge Quartet (KQ, Rowland, Huckstep & Thwaites, 2005), which has been present in several papers in past CERMEs was used by Bretscher (in this volume) to analyse interviews with teachers, and by Karlsson (in this volume) to analyse student teachers' lesson plans.

Teacher noticing

As the notion of teacher noticing has received more and more attention as a potentially meaningful aspect of teacher expertise (Aytekin & Bostan; Zindel, in this volume), it has also played a role in this TWG, in particular as far as its interrelatedness with teacher knowledge, beliefs and identity was concerned (Kilic, Dogan, Arabaci, & Tun, in this volume). The TWG20 group was aware that different definitions and conceptualisations of teacher noticing have been developed and that covering the full range of aspects of noticing would extend beyond the scope of this TWG. During the discussions, the participants acknowledged the need to be precise about the notion of noticing used. There might be intersection domains between aspects of noticing with models of teacher knowledge, for example, the “contingency” domain in the Knowledge Quartet model may be seen as covering some aspects of noticing. Relationships between noticing and teacher knowledge might even imply that noticing gets a “meeting point” for different models of teachers' knowledge. Also Interpretative Knowledge (Ribeiro, Mellone, & Jakobsen, 2016; Policastro, Ribeiro, & Almeida; Di Bernardo, Mellone, Minichini, & Ribeiro, in this volume) could be considered as such a “meeting point” of different teacher knowledge models.

Teacher beliefs and identity

Teachers' knowledge and beliefs are strictly intertwined, as it has been highlighted in a theoretical model used by many researchers who attended CERME11: i.e Mathematics Teachers' Specialized Knowledge (MTSK) model (Carrillo et al., 2018). Among the papers presented in the CERME11 TWG20, several studies make use of the term conception, assumed to include teachers' knowledge as well as their beliefs. Some of the papers presented in TWG20 dealt with teacher beliefs about specific topics: e.g. a study about different countries teacher's beliefs about Inquiry-Based Learning (Huang, Doorman, & van Joolingen, in this volume); two ongoing studies that aim at theorizing models that can be used to analyse and characterize teachers' conceptions of argumentation in mathematics teaching-learning processes and at arguing possible repertory grids to research teachers' conceptions of argumentation (Ayalon & Naama, in this volume; Klöpping & Kuzle, in

this volume); a study on teachers' conceptions about learning mathematics through classroom discourse (Kooloos, Oolbekkink-Marchand, Kaenders, & Heckman, in this volume). Other papers showed evidence of teachers' perspective about how to promote students' creativity (Sánchez, Font, & Breda, in this volume), of teachers' beliefs about the use of experiments in mathematics classroom (Geisler & Beumann, in this volume), and of student teachers' collective orientations on heterogeneity (Tewes, Bitterlich & Jung, in this volume). A transversal-issue discussed was the correlation between beliefs about mathematics and the styles of teaching in different contexts (Safrudiannur & Rott, in this volume). As underlined above, only one paper presented in the CERME11 TWG20 explicitly dealt with teacher identity (Rø, in this volume). Mathematics teacher identity has been explored from a range of theoretical perspectives; however, studies focusing on social practices and structures within which teacher identities develop seem to predominate in the research field (Rø, in this volume). Possible implications of focusing on teachers' identity were discussed in the TWG20, including theoretical considerations made when choosing an identity perspective. Taking an identity perspective on mathematics teacher learning, one can get insight into the participative experiences of (prospective) mathematics teachers, either when entering the profession or when moving across mathematics practices at university and school.

Transversal and new issues emerged

Cultural aspects

During TWG20 discussions the cultural issue emerged in a strong way. Although the cultural and context aspects were always part of research on "teacher knowledge, beliefs and identity", they often remain overshadowed or were even implicit in the papers. These issues cannot be considered as secondary when investigating on the curricular knowledge needed in different countries, on the teacher education programs, on the methodologies and activities that a teacher designs and develops in his/her classes. Also the use of research products, as well as the impact of the research, is very culturally dependent: e.g., the models used to describe and analyse teacher knowledge and their use in teacher education programs design are under the influence of cultural factors. The work carried out in the TWG20 gave researchers from different countries the opportunity to compare and ask their colleagues for information on different contexts and thus to reflect on how certain approaches and choices are specific to certain realities. It is important to specify that cultural and contextual aspects cannot be reduced to the content of curricula or only to organizational issues (such as the school systems or teacher education programs), but also include the beliefs about mathematics and teaching mathematics, different backgrounds, the roles of teacher educators, teachers and students in teaching-learning processes, the types of research carried out and the models applied to study them. Knowing and trying to understand other cultural contexts can help you better understand your own even though it is always very difficult to be aware and to analyse the features of the culture in which we are embedded. These reflections can be developed in all educational research and, in particular, in the research on "teacher knowledge, beliefs and identity": in fact, culture shapes teachers, teacher educators, and researcher.

Teacher education programs, teacher educators and tasks in teacher education

In the discussion on teacher knowledge, two transversal elements received attention: tasks, and mathematics teacher educators. The first element was considered as a research goal itself, in research focusing in how tasks aiming to foster knowledge development are built, but also a methodological tool to gather data about teacher knowledge. The second element regards the crucial role of the mathematics teacher educators (MTE) in the implementation of the tasks and the dynamics of in-service teacher training. The discussion around tasks for developing teachers' professional knowledge focused on three aspects: their design, their use to analyse teachers' knowledge, and their implementation. Concerning design, teachers' knowledge frameworks were used to guide it, using the frameworks' descriptors to structure the elements emphasized. In the papers presented, the design was founded in both MTSK and MKT frameworks, for example focusing on patterns (Aguilar, Ribeiro, & Ponte, in this volume) or on polygons (Montes, Climent, Carrillo, & Contreras, in this volume) or on rational numbers (Policastro, Mellone, Ribeiro, & Fiorentini, in this volume). Tasks were also used as a methodological tool to explore teacher knowledge, in particular, about definition (Codes, Climent, & Oliveros, in this volume), real numbers (Delgado-Rebolledo & Zakaryan, in this volume), and combinatority (Semanišínová & Hubeňáková, this volume). The implementation was slightly discussed as a part of the methodological section in the papers addressing tasks, yet receiving much more attention in the group discussion by emphasizing the role of MTE as the main agent in the implementation of the task. In addition to discussion on MTEs during papers which were not focusing on them, there were also papers focusing on MTEs (Mosvold & Hoover, in this volume; Almeida, Ribeiro & Fiorentini, in this volume). The discussion on TWG20 brought attention on them, as a key agent on the development of teacher knowledge. First, the term 'mathematics teacher educators' is not understood with the same meaning in each context, neither the content taught by them. It generated also a deep discussion the possibility to analyse MTEs knowledge with frameworks focusing (primary or secondary school) teacher knowledge. Second, and specially linked to research design, it was discussed how do MTEs impact on research. Finally, and related to the context-dependent meaning of some terms, teacher education programs received attention in the discussion and also in one paper (Estela-Caldatto & Ribeiro, in this volume), agreeing that researchers, MTEs, teachers and stakeholders need to link research on teacher knowledge, beliefs and identity and the design of teacher education programs.

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