

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

Miguel Ribeiro¹, Fatma Aslan-Tutak², Sebastian Kuntze³, Francesca Martignone⁴, Kirsti Rø⁵ and Amanjot Toor⁶

¹State University of Campinas, Brazil and Portugal

²Bogazici University, Istanbul, Turkey, Turkey

³Ludwigsburg University of Education, Germany

⁴Università del Piemonte Orientale, Italy

⁵Norwegian University of Science and Technology (NTNU), Norway

⁶Brock University, Canada

Rationale

The variety of papers presented in TWG 20 at CERME 2017 connected to the growing field of teacher education. There were total of 27 papers and 4 posters that had been presented. The number and heterogeneity of the research foci, contexts, methodological and theoretical approaches, provided opportunity for in-depth discussions and reflections around the presented papers. Although the core topic proposals were expected to embrace three intertwined domains, the focus of the presented papers at TWG20 was mainly on teachers' knowledge, while the topic of teachers' beliefs and teachers' identity would appear implicitly or in the background of some of the research.

Main topics

The priority given to teachers' knowledge can be seen throughout the unbalanced number of proposals which included the 27 papers presented (30 were submitted). For the development of the work three thematic strands have been considered: (i) knowledge in mathematics education (3 papers); (ii) lesson study context and beliefs (5 papers) and (iii) teachers' knowledge" (19 papers). It is interesting to note that the differences between (i) and (iii) concerns the aims of the research (even if not perceived explicitly), and not necessarily the theoretical perspectives considered.

(i) Knowledge in mathematics education. This thematic strand included three papers, focusing on aspects different from the specificities of teachers' knowledge, even when the context was teachers' education. Although the theoretical dimensions of the presented researches addressed teachers' knowledge conceptualizations the research focused on the knowledge of prospective teachers' that is revealed at the very beginning of teachers' training.

(ii) Lesson study. The second thematic strand included five papers and one poster, dealing with mathematics teachers' professional development (PD), in the context of the development of Lesson Studies (LS), and (prospective) teachers' learning with regards their own teaching practice and students learning, as well as on how teachers perceive themselves as participants in such LS context. Although there is evidence that PD contexts can lead to improvements in teaching practices and students' learning, less is known about what and how teachers learn from PD and about its further impact on students' learning outcomes (Borko, 2004), and also some other intertwined variables.

Common to the presented research were the perspective of considering teachers as learners, where the research is looking at the relationships between these two elements. In this thematic strand, two particular issues arise; how can theories/approaches/perspectives on teachers' knowledge be used to analyse the impact of teachers' participation and involvement in LS for teaching practices and professional development; concerning questions around the incorporation of theory in a methodological approach for LS in order to analyse the different phases and cycles.

Further, the research developed in the context of the implementation of a LS (or a research on the LS process), needs to take into account the particularities and specificities of the cultural contexts in which it is implemented – in order to acknowledge, the differences of those cultural contexts and the one where it is originated. In, and for doing so, one needs to take into account different aspects, such as the type, nature and impact of the affordances and constraints that takes into consideration; the influence of the researchers' background in the implementation, development and design of the research in the LS context; to what extent, in the context of a mathematics education research, the *mathematics* features of teaching is effectively the focus of attention.

(ii) **Teachers' knowledge.** Similar to previous CERME's, the explicit focus on teachers' knowledge has been given a major importance in the context of most of the presented proposals. The papers were grounded on teachers' knowledge conceptualizations that have already been discussed extensively in previous CERME conferences (Mathematical Knowledge for Teaching (Ball, Thames & Phelps, 2008); Mathematics Teachers' Specialized Knowledge (Carrillo, Climent, Contreras & Munoz-Catalan, 2013); Knowledge Quartet (Rowland, Huckstep & Thwaites, 2005); Ontosemiotic Approach (Godino, Batanero & Font, 2007)). We observe that, within a period of four years (from CERME 8 to CERME 10) a certain shift related to the focus of attention occurred, namely a shift from discussing the need for different conceptualizations towards an effort to deepening on the nature of teachers' knowledge when assuming a certain conceptualization.

In CERME9, Ribeiro, Aslan-Tutak, Charalambous and Meinke (2015) suggested that the use and development of diverse conceptualizations could be perceived as both a richness of the research field and as a constraint. The richness concerns possibilities for gaining a better insight into factors that influence the development of teacher knowledge. However, there are challenges of finding a common ground for discussing the core aspects of the research field. At the current conference, the issue of a diverse conceptualization was addressed in discussions on how to investigate mathematics teachers' knowledge when assuming it to be in interplay with students' learning. In other words, the need to pay "close" attention to how we, as researchers, take into consideration the aspects of mathematics teaching and learning, being connected to teachers' intertwined knowledge as well as to the role and impact of teachers' knowledge in practice concerning the use of resources (where the focus was the teachers' knowledge involved in/for preparing and using such resources – in a broader sense – in practice and not the resources itself).

The research, and the associated discussions and reflections in the group, also brought forward one of the recurrent items in the group discussions: the need for the research on teacher education to move from a prevalent focus on what teachers do not have (the deficit perspective – in term of knowledge) to a focus on what teachers actually know, how they know it, and possible different hows that can contribute to the development of teacher's knowledge, specifically related with teacher's work of teaching. Along the discussions, and aligned with some of the presented papers, a

possible direction for future research emerged on area of teachers' knowledge sustaining teachers' noticing and "earing" ability. For example, future research focusing on how mathematic teachers' pay attention to and make sense of what happens in the complexity of instructional situations (see e.g. Sherin, Jacobs & Philipp, 2011). Also on what aspects of one's knowledge do teachers' ground their decision making – in order to develop mathematically demanding practices, aiming at developing critical mathematical thinking for deeper mathematical understanding. One other possible focus concerns on how and why (the impact) the teachers' and researchers' knowledge influence their foci of attention and awareness.

Emerged themes and future perspectives

We have considered three thematic strands for an operational reason, but one need to have in mind the intertwined nature of such strands. Thus, in our case, the connecting element was teachers' knowledge. Some of the discussions were grounded in ideas already discussed in previous CERME's, aiming at deepening the understanding on those aspects/dimensions while other discussions seek for an alternative and complementary path for getting such a broader understanding. A particular sensitive aspect was the need for a deeper understanding on the relationships between teachers' knowledge and practice, and for gaining such a deeper understanding some new approaches to research on teachers' knowledge were discussed, in particular studies that investigate how teachers use their knowledge to give meaning to others' solutions or to anticipate students' answers. Moreover, the role of task design in and for assessing, accessing and developing teachers' knowledge and improving practices was emphasized in the discussions. We have grouped the main research trends emerged in three groups:

- Deepening research into teachers' knowledge, beliefs, identity, and noticing

- Taking into account that in some contexts mathematics teachers knowledge specificities are perceived mainly in the domain of PCK, how is the "weight" of PCK perceived in the field of research in mathematics education and how it intertwines with the specificities of the teachers' content knowledge, beliefs and identity?
- How to take into account teachers' noticing?

- Research on interactions with fields of practice

- How can the focus of research be intertwined with practice and education in a more explicit manner, perceiving practice in a broader sense?
- How can we investigate whether and how teachers' knowledge affects students' learning and transitions throughout student's education? How to design and develop research aimed at approaching "simultaneously" teachers' knowledge and students learning?
- How to move from frameworks for analyzing, describing, understanding and/or evaluating teachers' knowledge, to the use of frameworks by teachers (for analyzing teaching practice)?
- How the teachers' knowledge conceptualizations take into account the notion of assessment, and how does knowledge on assessment contribute to students' learning in mathematics?
- What are the roles and knowledge (e.g., features, nature, content) of mathematic educators in teacher education (e.g. facilitator in LS; teacher trainer)?

- Research on methodological (and theoretical) challenges:

- How can we deal with (and what are the implications for) similarities and differences of aims and challenges in mathematics teacher education in different cultural contexts?
- How to clarify the findings we have, when using a particular theoretical lens for analyzing teachers' answers, comments and/or practices?
- How to develop research that emphasize teachers' potentials instead of teachers' deficiencies, and how to design approaches for grounding teachers' knowledge development in such potential?
- As many of the researchers developing research on teachers' knowledge – in multiple contexts, including lesson study – are educators, how do we deal with such fact (a recurrent issue); what significant does researcher's role as an educator play on the research itself and what is the actual impact of research in improving teachers' education (in what terms is the research one does implying on the ways teachers' education occur)?

References

- Ball, D., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407.
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33(8), 3-15.
- Carrillo, J., Climent, N., Contreras, L.C. & Muñoz-Catalán, M.C. (2013). Determining specialized knowledge for mathematics teaching. In B. Ubuz, C. Haser & M. A. Mariotti (Eds.), *Proceedings of CERME8*, (pp.2985– 2994). Antalya, Turkey: Middle East Technical University.
- Godino, J.D., Batanero, C., & Font, V. (2007). The onto-semiotic approach to research in mathematics education. *ZDM*, 39(1-2), 127-135.
- Ribeiro, M., Aslan-Tutak, F., Charalambos, C., & Meinke, J. (2015). Introduction to the papers of TWG20: Mathematics teacher knowledge, beliefs and identity: Some reflections on the current state of the art. In K. Krainer & N. Vondrova (Eds.), *Proceedings of CERME9* (pp. 3177-3183). Czech Republic: ERME.
- Rowland, T., Huckstep, P., & Thwaites, A. (2005). Elementary teachers' mathematics subject knowledge: The knowledge quartet and the case of Naomi. *Journal for Mathematics Teacher Education*, 8(3), 255-281.
- Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (2011). *Mathematics teacher noticing: Seeing through teachers' eyes*. New York: Routledge.