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Introduction to TWG20: mathematics teacher knowledge, beliefs, and identity

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Rationale

The TWG 20 had 28 papers and 8 poster presentations. Due to the high number of participants, we had to split the group into two subgroups, A and B. We had 5 parallel paper sessions for each subgroup and one all group poster session. Like all other CERME TWGs, we used Padlet to share materials and reflections that were visible to both subgroups. The final session has been an all group discussion on the main crucial points discussed along the work developed. The discussions occurred around four main themes: (i) teacher knowledge and research – including the specificities of prospective and in-service teachers; (ii) teacher beliefs and identity; (iii) teacher knowledge and reflections and (iv) collaborative knowledge development. The discussions revealed the need to perceive and study teachers' beliefs, identity, teaching practice, emotions and teacher knowledge has a complex system, and the need to design (and to deepen in how to do it) and research collaborative professional development dynamics for teachers taking into account cultural context.

Here, instead of presenting what has been discussed in each one of the presented papers we opted for a more holistic approach: we present some of the main ideas and questions raised in collective discussions and at the end of TWG20 work, hoping that pursuing finding answers to such questions would lead us to advance to new paths and bring possible insights and approaches also to be discussed in the next CERMEs. For doing so we address the four main themes and conclude with some open questions and provocations for (possible) future work.

Teacher knowledge and research

Research on teachers' knowledge seems to have assumed naturally the existence of different teachers' knowledge models with all its diversity and focus on particular specificities of the knowledge considered. In both CERME9 and CERME11, there was an effervescence of model development. The focus was on their use for a deeper understanding of teachers' knowledge in various contexts and on various topics. The discussions developed in TWG 20 during CERME 12 revealed a research shift of attention from the knowledge teachers (don't) have to the knowledge teachers use to teach mathematics which lead to the "superman/woman teacher" idea and on how to deal with it.

The ideas, theoretical discussions and methodological viewpoints emerged can be summarized as:

- the role of teacher knowledge frameworks – discussing the importance of the different teachers’ knowledge models and knowledge conceptualizations and their use in and for research;
- research tools that “serve” both educators and researchers – focusing on the intertwined way of perceiving how the research tools can (should) be employed in both contexts (for teacher education and for doing research in and for teacher education);
- the need to pay attention to the specificity of teacher knowledge This problematic emerged associated to the large amount of research supposedly being done focusing in teachers’ mathematical knowledge that can be carried out similarly with students from the school level those (prospective) teachers are (will be) teaching.

Some of the emerging questions are:

- (a) What are the differences amongst prospective teachers and practice teachers in terms of content knowledge? Are we "taking care" of prospective teachers as teachers or as "older" students? And do we consider them in the work we do?
- (b) The focus of attention in teachers’ knowledge research has been mainly (in TWG 20) in prospective teachers, do we need to shift this focus and what are the affordances of and for doing so?
- (c) What are the differences amongst these groups in terms of mathematical and pedagogical knowledge and what are the implications of the research being done and of the conclusions obtained?
- (d) When doing research in prospective teachers, are we looking at the transition from student to teachers? What can we learn from that transition?

Teacher beliefs and identity

The themes of beliefs and identity have been addressed mainly in an intertwined manner to other issues. Teachers’ beliefs, identity, teaching practice, emotions and teacher knowledge seem to represent a complex system, in which each dimension informs the others in a direct or indirect manner. The discussions carried out on these themes during TWG20 can be synthesized around three main ideas:

- (a) the importance for prospective teachers and in-service teachers of collectively discussing and reflecting on core teaching practices for the development of their identity and their knowledge;
- (b) different definitions and conceptualizations of identity allow for the study of different aspects of teacher (learner) identity and change;
- (c) the relationship between teacher beliefs, culture and traditions: culture and traditions represent factors which inform beliefs.

Teachers' knowledge and reflections

Reflection is transversal to teachers' practices and thus, related with all the teachers' cognitions (and not only). A set of discussion went around reflecting on the relationships involving enactment of teacher knowledge on:

- (a) student thinking – associated to the research being done using student productions as a reflective tool and the analysis of students' assessment items for investigating teachers' knowledge;
- (b) online environment – choosing and implementing tasks for online learning environment, the (dis)advantages of each one of the tasks and its types and the knowledge involved and required;
- (c) developing measurement items – metacognitive aspect of developing measurement items to measuring teachers' knowledge and the different dimensions of knowledge being measured.

In this space of discussions, also influenced by experiences during the pandemic period, the online practices emerged in an interconnected explicit manner and some questions related worth mention:

- (i) What kind of practices allows teachers to improve themselves for online learning environment and what knowledge is involved?
- (ii) What does it mean to have a strong mathematical knowledge for teaching online? In what terms it differs from other contexts of teaching?
- (iii) How can different teacher knowledge models – considering or not explicitly technology – can be used for practical and methodological research purposes?

Collaborative knowledge development

The cultural dimension emerged strongly during the TWG meetings last CERME and TWG20 participants addressed it again during this CERME. There is the need to continue considering the international audience we have in the TWG and its cultural diversity in order to make explicit the particularities of the context research occurs. It will allow also the findings to be important to such a broader audience, and allowing, thus, contributing for the broader picture of improving the quality of research and its impact.

Some questions and reflections that emerged were:

- (a) How to design and research collaborative professional development for teachers taking into account cultural context?
 - (i) the need to a productive middle way between 'anything anywhere' and 'nothing nowhere' – the two ends of trying to implement anything anywhere or not implementing due to cultural factors are not beneficial;
 - (ii) the need for comparison and exchange between professional development programs in different local contexts for further understanding of both local contexts and important aspects in implementation and the research being done;
- (b) How to describe and/or analyze a cultural context that is useful in research relating to professional development?

- (i) the need to consider that the awareness of culture/context might not be enough leading to the need to be explicit in how and what ways the specificities of the cultural context are considered and impact on the research being done;
- (ii) the need for precise terminology for describing what was actually taken into account in the research being done so it can be also meaningful to a broader audience and impact on the more global level.

These questions were framed with the background of “*direction with potential*”, thinking on the research being done and its intertwining with teacher education and professional development programs – both with prospective and practice teachers. In that sense in a transversal manner to the discussions there were to topics of cooperation, comparison and extension of these professional contexts and the tasks involved both in micro, local and global levels of practices.

Transversal ideas and new emerging questions

The structure of the work carried out during TWG 20 was designed to move from the discussion of the specific papers presented (which can be perceived as case studies) to the elaboration of a set of possible new trends for research on teachers' knowledge, beliefs and identity in initial and continuing education contexts.

In doing so we have been able to frame new possible paths and inquiry questions that have, indeed guided some of the research being done afterwards and which reflect the problematic themes from this community. Some of these transversal ideas to all the discussions refers to:

- (a) a more concrete and explicit focus of attention in the connections and relationships between research and teacher education, emerging from: (i) the diversity of roles each one of us assume as researchers, teacher educators, and teachers; (ii) the research tools conceptualized and employed – e.g. tasks for data collection and its intertwined required relationship with teacher education;
- (b) a specific aim of considering the impact of what we do (in research) in what it's expected to be done in the future – in terms of public policy about teacher education.

Some of the emerging open questions are related to:

- (i) How researchers will manage zooming in on knowledge for teaching specific topics within a cultural context while zooming out of teacher knowledge models?
- (ii) How can we balance the role of cultural context in conducting research and implementing teacher education with developing common understanding from research results?
- (iii) What does it mean to have a “sound mathematical knowledge” allowing students to understand (online or not)? How can this be improved?
- (iv) How can we (researchers, educators) address, utilize and examine different definitions of identity?
- (v) How should we look into the system of teacher knowledge, identity, beliefs with lens of situated learning?