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Introduction to the work of TWG10: Diversity and Mathematics Education: Social, Cultural and Political Challenges

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Scope and focus

Thematic Working Group 10 has been active since CERME3 in 2004 and is focused on discussing mathematics education within the realms of *the cultural, the social and the political*. TWG10 builds on the premise that mathematics education is always more than an encounter between an individual and a mathematical object in a classroom setting. Instead it views such encounters as shaped, produced and reproduced in the context of wider cultural and societal contexts that are inherently social and political (Black et al, 2021). At the same time such encounters are viewed as contributing and constituting the contexts in which they are embedded in ways that reproduce, challenge or disrupt power relations. Research in this group is characterized by multiple efforts to reflect its own double-role in analyzing, shaping and reconfiguring mathematics education practices.

The group is specifically interested in research that investigates how diversity and difference is produced through mathematics education and how this process affects the possibilities, opportunities, obstacles, privileges and disadvantages associated with mathematics education. This includes issues of gender, race and ethnicity, language, socio-economic status, social class, disability, life opportunities, aspirations, worldviews and ideologies, school systems, governance structures, space, and settings. Additionally, diversity and difference may occur in relation to who is doing the research and who is being researched, posing methodological issues of an ethical, ontological and aesthetic nature. As all these multiple diversities and differences intersect, a reflective approach is expected in reporting what might be the effects of specific mathematics education reforms but also in discussing the effects of particular theoretical frameworks that attempt to frame and discuss mathematics teaching and learning in praxis. The group strives to unravel and contradict power relations between fields and how research depends on both theoretical and empirical assumptions in practice. Hence, to decenter oneself as a researcher is a strategy and joint endeavor in the team's collaborative work during the conference.

Organisation of TWG 10's work

Understanding research as a practice that is situated within diverse cultural, social, and political contexts has implications for practicing research *in situ*. During the conference, we organized the group to work in a way that 1) cultivated a change of perspective and fostered reflexivity and 2) created awareness about the effects of power relations that are always embedded in efforts to

understand, theorise and research diverse practices in mathematics education. Hence, we began our work in the group by posing core questions that are ongoing and have been a theme throughout the years in TWG10:

- What forms of exclusion or inequality are being created through mathematics education and how their visibility or invisibility becomes framed or narrated?
- What possibilities or opportunities are there for disrupting inequalities or exclusion in mathematics education?

Due to the rapidly changing landscape in education following from the pandemic, we added the questions:

- What new forms of exclusion or inequality has the COVID 19 pandemic created or made visible for mathematics education? Or are existing inequalities merely amplified?
- What possibilities or opportunities has the COVID 19 pandemic created for disrupting inequalities or exclusion in mathematics education?

In an attempt to make poster contributions visible to the whole group, they were also presented in the first session. This potentially stabilized the hierarchical distinction between papers and posters by ensuring they were reported and discussed by the group.

The development of reflexivity was sought by following the principle of *peer presentation*, namely that authors do not present their own paper, but give a short (5 minutes) presentation of a colleague's paper. This peer presentation included a description of the main ideas from the perspectives adopted in the paper and the formulation of questions from the presenter's own perspective. This was followed by a discussion in smaller break-out rooms between the author and reader - but also other TWG participants joined and added their reflections to the discussion. We finally held a joint discussion on interesting, important and challenging topics to put forward. In this way we sought to recognize research as a collective assignment that takes place in a network of social practices of dissemination, reflection, writing and problematizing as we shared and developed ideas, methodology and theory.

In order to encourage and also facilitate drawing connections between papers, they were grouped in sessions that were broadly thematic in some way. A number of papers focused on mathematics in a range of out-of-school settings provoking us to think about how localized mathematical practices relate to the mathematics curriculum. Ferrarello et al. presented findings from their project on Mathem-ethics in a prison setting in Italy, Solares-Rojas & Goizueta looked at the embedded mathematics utilized by Hñañu women embroiderers in Valle del Mezquital, Mexico and Francois & Vandendriessche reported on their ethnographic study of local activities described as string figure making in Northern Ambrymese society, Vanuatu. These papers raised debate regarding the paradox of validating mathematical knowledge from marginalized communities using academic mathematics and whether this really legitimates embedded mathematics or simply marginalizes in a different way.

Another common focus across the papers was teachers' understandings and experiences of marginalization and diversity. Gildehaus & Liebendorfer highlighted how a group of pre-service teachers often experience being positioned as less valued in comparison to mathematics majors on university mathematics courses. Xenofontos et al. explored teachers' perceptions of the causes of marginalization in school mathematics in Scotland highlighting the dominance of social class in

teachers' perceptions. Hummel & Bohlmann reported on pre-service teachers' understandings of diversity and their desire to acknowledge diversity in their future mathematics teaching but with limited knowledge of how to do so.

A third commonality between some of the papers was the recognition of diversity between students and how this might be both a challenge and a resource within classroom practices. In relation to gender, Foyn & Solomon focused on the challenges faced by a high performing girl, Sarah, whose experiences in the mathematics classroom are dominated by male performances of 'smartness'. The paper by Tiedke et al. focused on factors that influence the construct of low attainment prescribed by teachers - also highlighting the role of gender, in addition to self-concept and the quality of classroom management. A third paper by Ay highlighted differences between privileged and non-privileged students in their approach to modelling tasks outlining how more privileged students are able to unpack real world assumptions more readily when engaging with such tasks. Two papers also focused on recognizing differences between students as a resource for generating social transformation and change. Carrijo identified racial differences as a resource for investigation in the mathematics classrooms so that students may see their own lived realities in their mathematics activities. The paper by Ryan et al. focused on multilingual students' relocating of academic school mathematics across the home-school boundary - which, they argue, is a useful focus for pedagogic approaches that try to recognize home and community practices as a resource for learning mathematics.

Assessment was another theme that was addressed in two papers. Makrakis looked at how time and speed in national high stakes mathematics tests in Greece produces exclusion from mathematics. By contrast, Nieminen focused on an alternative framework that emphasizes students as co-designers of assessment (Universal Design for Learning), and explored how assessment frameworks may be designed to increase rather than hinder participation in mathematics and open up access for students with disabilities.

A larger group of papers investigated how research in mathematics education can produce social transformation both within the classroom and in society. Steflisch discussed teachers' perceptions of innovation in the mathematics classroom and categorized their responses into three types. The paper argues that those who struggle to stick to their pedagogic ideals rather than reverting to traditional pedagogic strategies may offer the most potential in terms of bringing about change. Lo Sophia et al. also focus on teachers' perceptions - but in relation to creativity in problem solving activities in the context of schools where there are high levels of student drop out. In addressing resistance to pedagogic change at a local level, Reinholz et al. discuss EQUIP - an observation tool which offers teachers/mathematics faculty with data on the link between social demographics and student participation in their own classroom as a tool for professional development. Plunger highlighted the necessity of learners' reflective processes for using mathematics to critique society - particularly, in relation to context orientated reflection. Buttitta & Di Paola discussed the concept of cultural transposition as a means to decentralise a didactic practice from a specific social and cultural context. Finally, Wright introduced the concept of socio-mathematical agency to critical mathematics education, which he defines as "the ability to use mathematics effectively to argue collectively for social change".

Another theme focused on developing critical thinking through mathematics education in ways that question socio-political bias and inequalities. Steffensen et al. presented findings on students' views

of the pandemic that demonstrate their ability to identify and use mathematics-based argumentation as a means to question a range of social inequalities. Andersson et al. highlight the challenge in doing this, outlining how discourses regarding the necessity of mathematics to democracy and citizenship make the development of critical thinking with mathematics difficult. Kollosche focused on questions regarding the epistemic status of mathematical knowledge itself. He proposed the ‘styles of reasoning’ framework as useful to critical mathematics education since it can help highlight the socio-political bias of mathematical knowledge without dismissing its objectivity altogether.

Finally, several papers discussed the COVID 19 pandemic and the way it has made visible hidden inequalities produced and reproduced through mathematics education. Vosbergen highlighted how the pandemic created a mathematics teacher shortage in the Netherlands which manifests a break down or blurring of the distinction of public and private education leading to questions regarding the quality of teaching and de-professionalization. Abtahi et al discussed the ethical issues made visible by the pandemic in doing mathematics education research. Lastly, Applebaum et al. pinpointed the pandemic as an example of a dystopic crisis that should be embraced by critical mathematics education suggesting the need to appropriate the tools of dystopia for local and indigenous struggles.

Common conclusions and open questions

TWG10 historically is orientated towards perspectives and methods that are more visibly located in other related disciplines of reference but not yet established within the field of mathematics (Abreu et al.). There is a strong emphasis on critical social theories and the questioning and deconstruction of concepts that are often taken for granted in mathematics education more broadly. CERME 12 was no different in this respect - group discussions on the above papers led to questions around the epistemic status of what we might term as ‘academic mathematical knowledge’ and how mathematics circulates across institutional boundaries with everyday practice. What are the power hierarchies at work here? This led us to consider whether the pandemic has created further in/out relations in mathematics education which linked back to the first session and indeed the conversations held within TWG10 in the CERME11 ¼ pre-conference meeting.

Additionally, a key tension in the group was around modelling and its function in critical mathematics education. Clearly, global crises such as the COVID 19 pandemic and climate change are generating more interest in modelling as a way to develop awareness and action for social justice. But the group also questioned how far modelling a role plays in the hegemonic reproduction of injustice and inequality and how we might prepare teachers to discuss this with students. This leads to a broader question: are we, as mathematics educators creating the problems of injustice that we are trying to solve?

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