

Topic Study Group 48

Mathematics in a Multicultural Environment

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ABSTRACT TSG-48 examined historical, current, and emerging trends as well as issues and experiences in research with/in/on multicultural environments, across four themes: theoretical perspectives, methodological perspectives, emergent perspectives, and knowledge mobilization perspectives.

Keywords: Multicultural environments; Mathematics education; Theory; Methodology; Emergent; Knowledge mobilization.

1. Description and Themes

1.1. Description

Mathematics education occurs in multicultural environments in all countries around the world. The aim of TSG-48 was to examine issues, and explore experiences, that arise in mathematics education policy, practice, and research with/in/on multicultural environments. Research, practice, and policies of/in/with mathematics education are affected by history, colonialism, decolonization, migration, and globalization. There is a growing body of research that is related to Indigenous perspectives, social justice, and equity within these historical and colonial environments. Research in mathematics education arising in such environments is growing and is of wide relevance. Four themes were featured.

1.2. Themes

Theoretical perspectives framing mathematics education with/in/on multicultural environments explored the questions: What theories have been used in conducting research with/in/on mathematics education in multicultural environments and why? What theories have been used to guide the teaching and learning of mathematics

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with/in multicultural environments? What are normative assumptions about mathematics education policy, practice, and research and multicultural environments? How might theory help to challenge normative assumptions? How has theory and research developed in the context of multicultural environments contributed to understanding the learning and teaching of mathematics more generally?

Methodological perspectives engaging mathematics education research with/in/on multicultural environments explored the questions: What new challenges have emerged in the methodological perspectives used in recent years? How might they be addressed? What perspectives have informed research with/in/on mathematics education in multicultural environments in recent years?

Emergent perspectives in framing research, teaching, and learning of mathematics education with/in/on multicultural environments explored the questions: In what ways are new perspectives informing the mathematics education research community about teaching and learning mathematics with/in/on multicultural environments? What are the ways in which these emergent perspectives inform teaching and learning of mathematics equitably? What challenges arise for mathematics teachers, mathematics educators, and mathematics education researchers when working with/in students' and families' diverse multicultural environments?

Knowledge mobilization perspectives explored the questions: How might research with/in/on mathematics education in multicultural environments inform curriculum and/or assessment policy? What challenges and opportunities arise in the interaction of mathematics education research with/in/on multicultural environments and the development and implementation of local, national, and international policy? What insights might be developed in the analysis of such interaction?

2. Program Overview

The Topic Study Organizing Team are the authors of the proceedings. Six contributions to the topic study group remained following the cancellation of ICME-14 in 2020 and the move to a hybrid format in 2021. In this section we firstly describe the format of the Topic Study Group sessions and then provide an abstract of the papers that were delivered.

2.1. Format

Two sessions of papers were facilitated during the ICME-14 meeting, on July 16 and July 17. The beginning of each session started with a welcome, facilitated by members of the organizing team. Following the presentations there was an opportunity for all individuals who presented and those who were listeners to dialogue around the ideas that were featured throughout the presentations. There were two long oral paper presentations and four short oral paper presentations. The long oral presentations were

scheduled for 30 minutes and the short oral presentations were scheduled for 20 minutes. The first paper in each session was a long oral presentation.

2.2. Presentations

Papers in TSG-48 are presented in Tab. 1. In the table, LO stands for long oral presentation, SO for short oral presentation.

Tab. 1. The list of presentations

Paper and author(s)
[1] Conceptualizing a framework for a new (disruptive) form of culturally responsive pedagogy in mathematics/teacher education. Kathleen Nolan (Canada). (LO)
[2] Preservice teachers engaging with traffic stop data to examine issues of bias. Anthony Fernandes (USA). (SO)
[3] Intersections of indigenous knowledge systems and mathematics education. Florence Glanfield (Canada). (SO)
[4] Taking a strengths-based approach to learning and teaching mathematics. Marta Civil (USA) and Roberta Hunter (New Zealand). (LO)
[5] Developing concepts for mathematics teaching units with a focus on migrant and minority students. Andrea Ulovec (Austria), Jarmila Novotná , and Hana Moraová (Czech). (SO)
[6] The use of dominant discourse practices in secondary multilingual mathematics classrooms: A comparison of lessons given by two teachers. Michael Alexander (South Africa). (SO)

A long oral presentation by Nolan^[1] explored the question of how school mathematics and mathematics teacher education might be reframed through critical and culturally responsive pedagogies. By synthesizing perspectives offered by Ethnomathematics (EM), Critical Mathematics (CM), Indigenous Education (IE), Language Diversity (LD) and Equity-based (E-b) approaches to research in mathematics education, Nolan conceptualizes a new (disruptive) form of culturally responsive pedagogy (CRdP). As discussed in this paper, CRdP is pedagogically informed by the EM-CM-IE-LD-E-b collective; it is theoretically informed by Nancy Fraser's (2009) three-dimensional approach to social justice and participatory parity; and it is methodologically informed by discourse analysis.

Fernandes^[2] reported on how ten preservice teachers, who were mostly White, engaged with local city traffic stop data to examine issues of racial bias. Police traffic stops are a common occurrence in the United States. Racial minorities, especially African Americans, are stopped at rates that are higher than other races. As data becomes more prevalent in society globally, it is important for teachers to be able to analyze and interpret large data sets. At the same time, teachers need to be familiar with issues that affect students they are going to teach. In the United States students of color are becoming a majority in schools, while their teachers come from different backgrounds and have different life experiences. An analysis of the pre- and post-reflections demonstrates that the preservice teachers associated the disproportionate traffic stops to actions of individual police officers rather than acknowledge racial bias in policing. The study showed that even though studying data can be an important tool

to understand structural inequities, a more comprehensive approach to changing dominant beliefs is needed.

Glanfield^[3] asked “In what ways might Indigenous knowledge systems shape mathematical understanding and mathematics teaching practices?” This paper described Indigenous knowledge systems and the ways that mathematics exists within Indigenous cultures. The paper illustrated the ways in which Indigenous knowledge systems have the potential to contribute to establishing and building inclusive, and equitable, classrooms. For example, one such aspect of many North American Indigenous knowledges is “we are all related.” This aspect points to the ways in which teachers can build on student, family, and community strengths for any classroom that is multi-cultural, not just Indigenous cultures.

Another long oral presentation^[4] by Civil and Hunter drew on research with teachers, students and parents to show how strength-based approaches can support culturally sustaining practices in mathematics classrooms. Although there has been a substantial increase in literature around teaching and learning of mathematics in multicultural settings we still have a way to go to gain equitable outcomes for all learners. Civil and Hunter illustrated how repositioning teachers from a traditional role as listened to, to that of being listeners, causes dissonance from which comes change towards culturally sustaining pedagogy. Civil and Hunter showed how authentic two way conversations between parents and teachers provide opportunities for learning with and from each other, not just about mathematics but also about their values and ways of being.

A joint paper^[5] by Ulovec et al. shared the work of a Czech-Austrian project team. The multicultural nature of society influences education in many countries. Teachers are usually not sufficiently prepared to deal with a multicultural classroom context. Particularly mathematics teachers feel the need for materials supporting them in teaching in multicultural classrooms. Mathematics teachers’ pupils with a migrant background often encounter more difficulties than their native classmates in acquiring basic mathematical skills. Many projects have created mathematics teaching materials in different settings, though these did not take multicultural classrooms into consideration. Few projects have created concrete mathematics teaching materials for migrants, but these were rather closed materials, not concepts and strategies to be further developed by teachers. The project team worked on designing concepts for teaching units based on the analysis of various research studies, examples of concrete teaching units based on these concepts, and guidelines on how to use these concepts. These materials will give mathematics teachers a tool that allows them to create their own teaching units fitting their own classroom needs.

Finally, Alexander^[6] explored some of the dominant discourse practices used in multilingual mathematics classrooms by comparing two teachers’ mathematics lessons on trigonometry in a Nigerian secondary school. Alexander started with an introduction, and then outlined a theoretical perspective on the nature of classroom interactions which informed the study. The research questions were: What dominant discourse practices were used by teachers as plainly demonstrated in their language (verbal and

non-verbal) in multilingual mathematics classrooms? How do teachers use language (verbal and non-verbal) to enact practices as reflected in their discourses in the teaching and learning of mathematics in multilingual classrooms? Data gathering techniques for the study included video observations in the classrooms, and written field notes. The data gathering process covered a period of six months. A total of 6 lessons were observed. Exploration of these practices lead Alexander to discuss a number of the relationships between teaching and learning of mathematics in multilingual classrooms. The analysis showed that teacher G used language to make his identity visible, as well as re-voicing and gesturing mathematically while teacher S used language not only to make his identity visible but also stabilise it during the discourses.

3. Future Directions and Suggestions

The presentations in TSG-48 highlight the diversity and complexity of research in multicultural environments. Though there were different foci, we find some underlying themes that point to future directions in research. It is important to take a strengths-based approach when working in a multicultural environment. Students effectively draw on their language and lived experiences in the mathematics classrooms. Current research around trans-language is also a step towards new understanding of learning and teaching mathematics in a multicultural environment. Further, exposing future teachers and teachers to these approaches is key to future research directions.

Providing future teachers with experiences and opportunities to dialogue is an area that needs more research. Discussions around racism, colonialism, and sexism can remain controversial within a mathematics classroom. Research related to curriculum and classroom implementation remains an important future direction in research.

We also noted that, on terms of methodological approaches, the research presented in Topic Study Group 48 was primarily qualitative. We wondered, what quantitative or mixed approaches might be developed to offer other perspectives of mathematics in a multicultural environment in the future?

References

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