CRITICAL MATHEMATICAL THINKING FOR SUSTAINABLE FUTURES

Julia Aguirre[1], Chiara Andrà[2], Kim Beswick[3], Alf Coles[4], Sarah Digan[5], Vince Geiger[5], Jodie Hunter[6], Stefan Siller[7], Armando Solares[8], Jennifer Suh[9], Eva Thanheiser[10], Nina Unshelm[7] and David Wagner[11]

University of Washington[1], Università del Piemonte Orientale[2], University of New South Wales[3], University of Bristol[4], Australian Catholic University[5], Massey University[6], University of Wuerzburg[7], CINVESTAV[8], George Mason University[9], Portland State University[10], University of New Brunswick[11]

We will present data from some on-going studies and engage in discussion around what is critical mathematical thinking and how is it relevant to a mathematics education for sustainable futures. Questions of how the mathematics curriculum relates to socio-ecological challenges and precarity are increasingly present in our field (as seen, for example, in "global sustainability" theme of PME46). The Working Group aims to keep conversations going in our community about the impact of issues such as climate change on teaching and learning mathematics.

BACKGROUND

This Working Group will report on ongoing research and provide opportunity for scholars working in the field to make connections between their research that others are conducting across the globe. The Group also welcomes, in particular, scholars who are new to research related to critical mathematical thinking and sustainable futures. Previous Working Groups (2020, 2021, 2022) have conducted discussions concerned with curriculum innovation in light of global changes/uncertainties and associated methodological approaches. In 2023, a Research Forum reported on a Special Issue, "Mathematics curriculum innovation in precarious times" (le Roux et al., 2022). In this Working Group we look to extend previous discussion and draw on new initiatives, through a focus on Critical Mathematical Thinking and how this relates to issues of sustainability, as well as considering alternative frameworks and approaches. It is our hope that these new discussions will build momentum towards further joint writing.

CRITICAL MATHEMATICAL THINKING

The capacity to apply mathematics critically is essential for forming balanced judgements and making prudent decisions about economic, health, environmental and other challenges faced by society. Critical Mathematical Thinking (CMT) involves the application of mathematics to complex real-world problems in a wide range of contexts. Identifying the impact of proposed solutions to real-world problems on individuals and society and how these can be addressed is also a key dimension of CMT. An inability to engage CMT when applying mathematics to real-world problems leads to fewer life opportunities, especially for the marginalised and disadvantaged.

2024. In T. Evans, O. Marmur, J. Hunter, G. Leach, & J. Jhagroo (Eds.). *Proceedings of the 47th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 82-83). PME.

Despite its importance, there have been few empirical studies focused on developing CMT in school classrooms, and there is little evidence that current curriculum and pedagogical responses to this challenge have been effective. We know, however, that developing the critical capabilities needed to apply mathematics to real-world problems is a challenging goal (e.g., Geiger et al., 2015). Developing critical mathematical thinking, therefore, is a significant aim in relation to how mathematics education might contribute to sustainable futures for the planet, in addition to other disruptive phenomena (recognising the contested nature of the word "sustainability").

GOALS OF THE WORKING GROUP

In this Working Group we will be developing responses to the following key questions: (1) What is critical mathematical thinking and how does it develop? (2) How can mathematics education make a positive contribution towards sustainable futures? (3) How is critical mathematical thinking relevant to sustainable futures? (4) What methodologies might support work on the questions above?

ACTIVITIES AND TIMETABLE

Session 1: Introduction to ideas of "critical mathematical thinking" and "sustainable futures" with reference to aims and outcomes of past work at PME (2020-2023). (20 mins); Enabling Critical Mathematical Thinking (Geiger) (15 min). Discussion (with a facilitator): Issues around developing criticality in your context/other related perspectives? (20 min); Strengthening Teachers' Instructional Capability with Big Data and Sustainability (Siller) (15 min). Discussion (with a facilitator): How might sustainability enter your work? (20 mins); Plenary discussion to collate common themes from small group discussion. "Gap task": What research questions are provoked? What methodologies/frameworks? (25 mins)

Session 2: Feedback on "gap task" and collation of responses (15 mins); Updates on recent thinking relating to criticality/sustainable futures (Andrà, Coles, Hunter, Thanheiser) (20 min). Discussion (with a facilitator): Common themes and issues (25 min); Small group discussion, around identified issues/common areas of interest. (30 mins); Closing discussion: Feedback and next steps for future collaborations. (30 mins)

References

Geiger, V., Forgasz, H., & Goos, M. (2015). A critical orientation to numeracy across the curriculum. *ZDM - Mathematics Education, 47*(4), 611-624. https://doi.org/10.1007/s11858-014-0648-1

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