Topic Study Group 5.3: Cognition, learning sciences, and neurosciences in mathematics education

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Team details*

Co-Chairs

Mona Nosrati (Norges Teknisk-Naturvitenskapelige Universitet, Norway; mona.nosrati@matematikksenteret.no)

Jo Van Hoof (University of Turku, Finland; jo.vanhoof@utu.fi)

Members

Florence Gabriel (University of South Australia, Australia)

Biyao Liang (The University of Hong Kong, Hong Kong)

IPC Liaison

David M. Gómez (Universidad de O'Higgins, Chile)

Overview

Cognitive psychology, learning sciences, and neuroscience can provide valuable insights into how students learn mathematics and how to design effective instructional materials and approaches for teaching mathematics. For example, research in cognitive psychology has identified a range of cognitive skills that are associated with learning mathematics, including working memory, inhibition and spatial skills. Some key insights that have emerged from learning science research include a shift towards more active learning (including physical activity), favouring deeper conceptual understanding over superficial procedures and the importance of learning authentic knowledge.

* *Team details correct at time of print; 28 April 2023*

Neuroscience research has also identified brain regions that are involved in mathematical thinking and has explored how different teaching methods can impact the brain's ability to learn mathematics. These insights can inform the development of teaching practices and educational resources that are more effective in helping students achieve better mathematics outcomes.

Even though these disciplines have the potential to bring substantial and meaningful advancements to educational practices, challenges remain. These challenges are most apparent when it comes to physical and temporal scales and contexts, which range from the study of neurons in the brain over the course of seconds or minutes, to the development of the learner over years, and within complex environments.

Areas of interest

TSG5.3 aims to bring together the three research communities of cognitive psychology, learning sciences, and neuroscience. Major research findings gained in the last years, as well as the accompanying research methods used to uncover these findings, will be discussed.

More specifically, the TSG will start with a general discussion addressing the question of where the three research fields intersect, what they can learn from each other, and which possible challenges still remain. Subsequently, three key themes will be addressed. Within cognitive psychology, the key theme is the role of executive functions in learners' mathematical development. In the field of learning sciences, the main theme will explore learning trajectories with a specific focus on how early mathematics skills build the basis for children's later mathematics development.

Lastly, in neuroscience, the focus will be on how findings from neuroscience research can translate into the classroom, both within teachers' daily work and intervention programs. Emphasis will be put on teachers' knowledge about the brain, where this knowledge might come from, and how it influences their teaching of mathematics. Importantly, within each theme, attention will be given to making bridges between the three research fields.

- Where do the research fields of cognition, learning sciences, and neurosciences intersect?
- What can they learn from each other, and which possible challenges still remain?
- What is the role of executive functions in learners' mathematical development?
- How do early mathematics skills build the basis for children's later mathematics development?
- How can findings from neuroscience research translate into the classroom?

How to make a submission to this Topic Study Group

Submissions for Topic Study Group Papers and proposals for Posters open 28 April 2023 via the official ICME-15 website, icme15.org. The website also contains a timeline of dates for the activity of the Topic Study Groups in the lead up to the Congress.

For questions about this TSG, please contact the Co-Chairs using the email addresses provided.