Topic Study Group No. 19: Problem Solving in Mathematics Education

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Guido Pinkernell and Laurent Vivier**

Mathematical problem solving has been an important research and practice domain in mathematics education worldwide. It's agenda focuses not only on analysing the extent to which cognitive, social, and affective factors influence and shape learners' development of problem solving proficiency, but also on the role played as a medium for teaching and learning mathematics and the development of both teachers' and learners' problem solving proficiencies. TSG 19 on Problem Solving in Mathematics Education was dedicated to the furthering and sharing of knowledge on this important topic.

To this end, the mathematics education community was invited to submit contributions that address the aforementioned themes relevant and related to Problem Solving in Mathematics Education. We received 56 submissions from 30 different countries on a wide range of problem solving related topics. From these 56 submissions 15 papers were accepted to be presented as part of our main TSG program (15 min presentation, 5 min discussion) as well as 27 papers to be presented as an oral communication (10 min presentation, 5 min discussion). Within the main TSG program the following 15 papers were presented:

Co-chairs: Peter Liljedahl, Manuel Santos-Trigo.

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- *A Framework for Undergraduate Students' Mathematical Foresight*
Wes Maciejewski, Bill Barton
University of Auckland, New Zealand
- *Looking Back to Solve Differently: Familiarity, Fluency, and Flexibility*
Hartono Tjoe
The Pennsylvania State University, USA
- *Do High- & Low-Achieving Third Graders Benefit in the Same Way from Representational Training when Solving Word Problems?*
Nina Sturm, Renate Rasch, Wolfgang Schnotz
University of Koblenz-Landau, Germany
- *Classroom Practices for Supporting Problem Solving*
Peter Liljedahl
Simon Fraser University, Canada
- *Concretizing Mathematical Problem Solving with Metaphors*
Yee, Sean P¹, Thune-Aguayo, Ashley²
¹University of South Carolina, USA; ²California State University, USA
- *Problem Solving in Varga's Reform of Hungarian Mathematics Education: The Case of Combinatorics*
Katalin Gosztonyi
University of Szeged, Hungary
- *How do Children's Solutions Change when they Solve the same Word Problem in Math and Religion Class?*
Johansson, Juha Antero
University of Helsinki, Finland
- *Assessing IBME with Summative and Formative Purpose*
Maud Chanudet
Université de Genève, Suisse
- *Beyond the Standardized Assessment of Problem Solving From Products to Processes*
Pietro Di Martino, Giulia Signorini
University of Pisa, Italy
- *Toward Developing an Instrument to Assess Mathematical Problem Solving*
James A. Mendoza Epperson, Kathryn Rhoads, R. Cavender Campbell
The University of Texas at Arlington, United States of America

- *Pre Service Teachers' Problem Solving Ability in Secondary Level Mathematics (Algebra and Number)*

Aoife Marie Guerin, Olivia Fitzmaurice, John O'Donoghue
University of Limerick, Ireland

- *Mathematical Problem Solving With Technology: The Case of Marco Solving-and-Expressing on the Screen*

Hélia Jacinto^{1,2}, Susana Carreira^{2,3}

¹Jorge Peixinho Secondary School; ²UIDEF, Institute of Education, University of Lisbon; ³University of Algarve

- *The Spreadsheet Affordances in Solving Intricate Algebraic Problems*

Nélia Amado^{1,2}, Susana Carreira^{1,2}, Sandra Nobre^{2,3}

¹University of Algarve, Portugal; ²Research Unit of the Institute of Education, University of Lisbon; ³Group of Schools Paula Nogueira, Portugal

These presentations, together with the 27 oral communication presentations, were organized into one of 10 themes.

1. problem solving processes
2. problem solving settings
3. problem solving assessment
4. problem posing
5. technology and problem solving
6. meta-cognition and problem solving
7. professional development of problem solving
8. affect in problem solving
9. heuristics and strategies
10. classroom culture and discourse

Much was learned from these 42 presentations about problem solving in general, and about the 10 aforementioned themes in particular. Looking across the corpus of research presented at TSG 19, and across the many diverse and, sometimes contradictory, conclusions a number of key questions began to emerge.

- What is the role of goals in problem solving?
- What is the role/status of heuristics in problem solving?
- What is the utility of Pólya's *look back* stage?
- How to position problem solving in textbooks and curriculum?
- How to assess problem solving so that it is still problem solving?
- What is the role of the extra-logical processes in problem solving?
- How does the availability of tools/technology impact problem solving processes?

Although these questions have been addressed in the literature previously, the research presented at ICME-13 indicated that more work is needed to more adequately understand the answers to, and implications of, these questions.

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