Topic Study Group No. 48: Pre-service Mathematics Education of Secondary Teachers

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The Programme

During Topic Study Group 48 regular sessions, significant new trends and developments in research and practice on the mathematics education of prospective secondary teachers were discussed. An overview of the current state-of-the-art and recent research reports from an international perspective were provided. In keeping with the call for papers, presentations focused on similarities and differences related to the development of mathematics content and pedagogical content knowledge of teachers; models and routes of teacher education, curricula of mathematics teacher education; the development of professional identities as prospective mathematics teachers and a variety of factors that influence these different aspects; field experiences and their impact on prospective secondary mathematics teachers' development of the craft of teaching; the impact of the increasing availability of various technological devices and resources on preparing prospective secondary mathematics teachers; and others.

We received fifty-four 4-page submissions to TSG 48. From the submissions, 20 papers were selected for presentations during the regular meetings. Each of these 20 papers was scheduled in one of the following TSG sessions based on the topic of the paper: (1) Field Experiences (two sessions); (2) Prospective Teachers

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Knowledge (two sessions); (3) Technologies, Tools and Resources (one session); and (4) Prospective Teachers Professional Identities (one session). Also, we invited four speakers to submit an extended article, one for each of the major themes: Blake E. Peterson and Keith R. Leatham (field experiences), João Pedro da Ponte (teachers' knowledge), Rose Zbiek (tools, technologies, and resources), and Márcia Cristina de Costa Trindade Cyrino (teachers' identities). Thus, 24 papers were scheduled for the TSG 48 regular meetings. We had 3 cancellations. Below is a list of the regular session presenters and the titles of their presentations:

Field Experiences

- Peterson, Blake E. & Leatham, Keith R.; The Structure of Student Teaching Can Change the Focus to Students' Mathematical Thinking.
- Martin, W. Gary & Strutchens, Marilyn E.; Transforming Secondary Mathematics Teacher Preparation via a Networked Improvement Community.
- Akcay, Ahmet Oguz; Boston, Melissa; An Examination of Pre-Service Mathematics Teachers' Integration of Technology into Instructional Activities.
- Potari, Despina & Psycharis, Giorgos; Prospective Mathematics Teachers' Argumentation While Interpreting Classroom Incidents.
- Kilic, Hulya; Pre-Service Teachers' Reflection on Their Teaching.
- Heinrich, Matthias; Consequences from the Learning Level of Students for the Lesson Planning in Mathematics.
- Jackson, Christa DeAnn & Mohr-Schroeder, Margaret; Increasing Stem Literacy via an Informal Learning Environment.
- Losano, Leticia & Villarreal, Mónica; Prospective Teachers Working Together Before and During Their First Teaching Practices.

Teachers knowledge

- da Ponte, Joao Pedro; Lesson Studies in Preservice Teacher Education.
- Arnal-Bailera, Alberto; Cid, Eva; Muñoz-Escolano, José M.; & Oller-Marcén, Antonio M.; Marking Mathematics Exams as a Tool for Secondary Teacher Training.
- Juhász, Péter; Kiss, Anna; Matsuura, Ryota; & Szász, Réka Judit; Developing Teacher Knowledge in Preservice Teachers through Problem Solving and Reflection.
- Lin, Fou-Lai; Yang, Kai-Lin; & Chang, Yu-Ping; Designing a Competence-Based Entry Course for Prospective Secondary Mathematics Teachers.
- Manouchehri, Azita; Infusing Mathematical Modeling in Teacher Preparation: Challenges and Outcomes.
- Chang, Yu-Ping & Yang, Kai-Lin; Apos Theory Applied to Identify Key Challenges for Improving Prospective Mathematics Teachers' Teaching.
- Park, Jung Sook; Oh, Kukhwan; & Kwon, Oh Nam; An Exploratory Study on the Prospective Teachers' Lesson of Analyzing Math Textbooks.
- Olmez, Ibrahim Burak; Izsak, Andrew; & Beckmann, Sybilla; Future Teachers' Use of Multiplication and Fractions When Expressing Proportional Relationships.

Technologies, tools and resources

- Zbiek, Rose Mary; Framing Secondary Mathematics Teacher Understanding.
- Moreno, Mar; & Llinares, Salvador; Prospective Secondary Mathematics Teachers' Perspectives about the Use of Technology for Supporting the Maths Learning.
- Wu, Yingkang, Promoting Pre-Service Secondary Mathematics Teachers' Learning to Teach Mathematics: A Video-Based Approach.

Teachers professional identities

- Cyrino, Márcia Cristina de Costa Trindade, Teacher Professional Identity Construction in Pre-Service Mathematics Teacher Education: Analyzing a Multimedia Case.
- Hine, Gregory Stephen Colin, Exploring Pre-Service Teachers' Self-Perceptions of Readiness to Teach Mathematics.
- Durandt, Rina; & Jacobs, Gerrie J, Pre-Service Teachers' Attitudes towards Mathematical Modelling.

Next highlights from the regular TSG 48 sessions are presented. A major theme discussed in the field experiences sessions is the notion of creating opportunities for prospective secondary mathematics teachers (PSMTs) to learn effective strategies for teaching students and simultaneously ensure that their students are developing the mathematical skills and knowledge that they need. Three presentations (Peterson & Leatham; Martin & Strutchens; Losano & Villarreal) focused on structuring field experiences in such a manner that more than one teacher candidate is placed with the same mentor teacher to capitalize on collective planning, teaching, and monitoring of student growth, as well as fostering student-focused teaching strategies for the teacher candidates. Other papers (Potari & Psycharis; Heinrich) focused on teacher candidates noticing students' actions and asking the appropriate questions or redirecting instruction to better meet students' needs. Jackson and Mohr-Schroeder helped participants to think about field experiences that go beyond the regular mathematics classroom and that help teacher candidates to connect mathematics to other STEM areas. Akcay and Boston presented a study that determined pre-service teachers' ability to integrate technological tools into instructional activities and showcase portfolios in mathematics in ways that support students' high-level thinking and reasoning. Participants were also happy to support Hulya Kilic who had to present her talk virtually, since academic travels abroad were forbidden by the Turkish government during the time of the conference.

Within the PSMTs' teacher knowledge sessions, 'structures in mathematics teacher education that support the development of PSMTs' knowledge' was a major theme. Ponte reviewed studies which focused on lesson study in teacher education and addressed emerging challenges. He described strategies that have been used in teacher education, such as microteaching, reflection in oral and written-form, and face-to-face and digital context for planning and reflecting. He also discussed the constraints that exist in using lesson study in initial teacher education. Arnal-Bailera et al. discussed how grading mathematics exams can be embedded in PSMTs' programs in ways that promote reflection and provide opportunities for professional

learning. Park, Oh, and Kwon addressed the analysis of textbooks as an approach in teacher education to bring PSMTs closer to the curriculum and to their future work as teachers. Lin, Yang, and Chang discussed a course in which PSMTs had opportunities to understand students' mathematical thinking, cultivate the competencies of exploration and practice, and develop positive beliefs towards mathematics teaching and learning.

In the second session on PSMTs' knowledge, four presentations focused on teacher education practices related to specific mathematical content areas and processes. Manouchechri's study prepared PSMTs to become familiar with mathematical modelling. The study shows that teachers experienced difficulty enacting the mathematical practice of mathematical modelling. Lin and his colleagues examined PSMTs' teaching of mathematical induction in the context of their field experiences. Juhász et al. focused on the development of PSMTs content knowledge and pedagogical content knowledge in a teacher education course based on problem solving. Finally, Ölmez, Izsák, and Beckmann pointed out that the quantitative definition for multiplication is linked to PSMTs capacity to visualize the relationships between the multiplier and multiplicand in strip diagrams. Coincidentally, the research threads discussed in PSMTs' knowledge reflected the same emphases as some of the studies found in the topical survey that the group published (Strutchens et al., 2016).

Three presentations were given in the technology focused session. Zbiek discussed the conceptual tools for framing secondary mathematics teacher preparation and technology use. She argued that TPACK (Technological, Pedagogical, And Content Knowledge), long used as a framework for knowledge and recently proposed as an orientation towards technology use, is productively enriched by elaboration. Within this frame, she further illustrated conceptual tools for framing technology, content, and pedagogy. She suggested that PSMTs should encounter multiple forms of technology in all venues of their preparation: content courses, pedagogy course, and practical experiences. Wu examined how PSMTs learn to teach mathematical concepts via a video-based approach. The participants' reflection reports documented how they learned from an expert teacher, their peers, and self-reflections. Moreno and Llinares shared PSMTs' perspectives on the use of technology for supporting mathematics learning. They found that PSMTs perspectives on the use of technology were defined by the way in which technological resources were used and the nature of the mathematical activity.

Two papers were presented at the session devoted to PSMTs' professional identity. They revolved around two notions related to identity. The first one is PSMTs' *self-perceptions* and was employed by Hine in his analysis of how PSMTs understand and perceive their "readiness" to teach mathematics based on their pre-service education. The second one, employed by Durandt and Jacobs, is PSMTs' *attitudes*. The authors investigated PSMTs' attitudes towards modeling based on their initial exposure to a model-eliciting task. Although invited speaker, Márcia Cyrino, was unable to attend the congress due to force majeure

circumstances, her article¹ introduces new aspects for the notion of identity. Particularly, her work highlights that identity is related to *agency* and *vulnerability*. One of the issues discussed during the session was the following: What are the theoretical links between the notions of belief, attitude, conception, emotion, agency and identity? Furthermore, participants agreed on the importance of reflecting on methodological tools for collecting data—interviews, narratives, surveys, field notes, etc.—best suited for capturing not only the PSMTs’ self-perceptions, attitudes and professional identity but also its development.

Overall, TSG 48 sessions were well received and attended. Participants were intrigued that the countries had so many issues in common around prospective secondary mathematics teacher education.

Reference

Strutchens, M., Huang, R., Locano, L., Potari, D., Ponte, J. P., Cyrino, M. C., et al. (2016). *The mathematics education of prospective secondary teachers around the world*. ICME-13 Topical Surveys. Berlin: Springer.

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¹Cyrino, M. C. T. Teacher professional identity construction in pre-service mathematics teacher education: analysing a multimedia case.