Topic Study Group No. 47: Pre-service Mathematics Education of Primary Teachers

Keiko Hino, Gabriel J. Stylianides, Katja Eilerts, Caroline Lajoie and David Pugalee

The Programme

Topic Study Group 47 (TSG 47) included paper presentations on significant new trends and developments in research, theory, and practice about all different aspects that relate to the mathematics education of pre-service primary teachers. The phrase "different aspects" was interpreted broadly to include (among others) the following:

- pre-service teachers' mathematics-content preparation as well as their mathematics-specific pedagogical preparation;
- pre-service teachers' mathematical knowledge for teaching as well as their beliefs about mathematics or mathematics teaching and learning;
- textbooks and other curriculum materials as well as assessment tools used in mathematics teacher education programs for pre-service teachers;
- pre-service teachers' experiences in mathematics classrooms and issues related to their school placements; and
- teacher educators' knowledge for teaching pre-service teachers.

TSG 47 offered a forum for an overview of the current state-of-the-art, invited contributions from experts in the field (Fou-Lai Lin and Skip Fennel), presentation of high-quality research reports from TSG participants, and discussion of directions

Co-chairs: Keiko Hino, Gabriel J. Stylianides.

Team members: Katja Eilerts, Caroline Lajoie, David Pugalee.

K. Hino (✉)
Utsunomiya University, Utsunomiya, Japan
e-mail: khino@cc.utsunomiya-u.ac.jp

G.J. Stylianides
University of Oxford, Oxford, UK
e-mail: gabriel.stylianides@education.ox.ac.uk

G. Kaiser (ed.), *Proceedings of the 13th International Congress on Mathematical Education*, ICME-13 Monographs, DOI 10.1007/978-3-319-62597-3_74

for future research. In discussing the findings of research studies that took place in different countries, the TSG participants also had an opportunity to learn about practices used around the world in relation to the mathematics education of pre-service primary teachers such as similarities and differences in the formal mathematics education of teachers, types and routes of teacher education, and factors that can influence similarities or differences.

Associated with the TSG there were in total 19 regular presentations (8-page papers), 29 oral communications (4-page papers), and 18 posters. The regular presentations (8-page papers) were organized around five themes as described below. Although several presentations (and associated papers) addressed issues that spanned several themes, practical considerations related to the organization of the TSG sessions during the conference necessitated a best-fit approach.

Theme 1: Mathematics-Content and Mathematics-Specific Pedagogical Preparation

This theme is about the mathematical and pedagogical aspects of teachers' preparation in teacher education. The following presentations were offered under this theme:

- Using mathematics-pedagogy tasks to facilitate professional growth of elementary pre-service teachers (Fou-Lai Lin and Hui-Yu Hsu)
- Investigating the relationship between prospective elementary teachers' math-specific knowledge domains (Roland Pilous, Timo Leuders, and Christian Rüede)
- A self-study of integrating computer technology in a geometry course for prospective elementary teachers (Jane-Jane Lo)
- Pre-service elementary teachers generation of multiple representations to word problems involving proportions (Ryan Fox)

Papers emphasized the importance of pedagogy focused tasks to promote professional growth (Lin and Hsu). Papers focusing on content explored math-specific domains (Pilous et al.), specific areas such as proportional reasoning (Fox), and the role of computer technology in geometry (Lo).

Theme 2: Activities and Assessment Tools Used in Mathematics Teacher Education Programs

This theme is about activities and tools for assessing prospective teachers' knowledge or skills used in mathematics teacher education programs. The following presentations were offered under this theme:

- Preparing elementary school teachers of mathematics: A continuing challenge (Skip Fennell)
- Designing non-routine mathematical problems as a challenge for high-performing prospective teachers (Marjolein Kool and Ronald Keijzer)
- Preservice teachers' procedural and conceptual understanding of fractions (Eda Vula and Jeta Kingji-Kastrati)
- Appraising the skills for eliciting student thinking that preservice teachers bring to teacher education (Meghan Shaughnessy and Timothy Boerst)

Fennell presented current and emerging challenges related to elementary education programs in the United States. Effective characteristics of the learning environments were found through prospective teachers' activities of designing non-routine mathematical problems (Kool & Keijzer). Through various assessment tools, certain aspects of teachers' content knowledge or teaching skills were found to be in need of more stimuli or to be built in teacher preparation programs (Vula & Kingji-Kastrati, and Shaughnessy & Boerst).

Theme 3: Mathematical Knowledge for Teaching and Beliefs

This theme is about the mathematical knowledge that teachers need for their work and about teachers' beliefs and how the might affect teaching practice. The following presentations were offered under this theme:

- A study of prospective primary teachers' argumentation in terms of mathematical knowledge for teaching and evaluation (Yusuke Shinno, Tomoko Yanagimoto, Katsuhiro Uno)'
- Image vignettes to measure prospective teachers' beliefs about mathematics teaching and learning (Stephanie Schuler, Gerald Wittman)
- The mathematics background and mathematics self-efficacy perceptions of pre-service primary school teachers (Gonul Gunes)
- Developing together: measuring prospective teachers' intertwined, topic specific knowledge and beliefs (Erik Jacobson, Fetiye Aydeniz, Mark Creager, Michael Daiga, Erol Uzan)

The sessions provided multiple perspectives on the mathematical knowledge and beliefs for teaching at the primary level. Participants explored self-efficacy as it relates to pre-service teachers' mathematics background. Measures of knowledge and beliefs were the focus of several sessions including the use of image vignettes and teachers' beliefs for topic specific knowledge. Mathematical knowledge for teaching and evaluation was explored in terms of argumentation.

Theme 4: Experiences in Mathematics Classrooms/Teacher Educators' Knowledge for Teaching

This theme is about prospective teachers' experiences in mathematics classrooms or opinions about the learning opportunities for teaching to diverse students in the teacher education programs, and the work of mathematics teacher educators. The following presentations were offered under this theme:

- Preservice mathematics teachers' gains for teaching diverse students (Derya Çelik, Serhat Aydın, Zeynep Medine Özmen, Kadir Gürsoy, Duygu Taşkın, Mustafa Güler, Gökay Açıkyıldız, Gönül Güneş, Ramazan Gürbüz, and Osman Birgin)
- The day will come when I will think this is fun: First-year pre-service teachers' reflections on becoming mathematics teachers (Elisabeta Eriksen, Yvette Solomon, Camilla Rodal, Bjørn Smestad, and Annette Hessen Bjerke)
- Learning and teaching with teacher candidates: An action research for modeling and building faculty school cooperation (Oğuzhan Doğan and Hülya Kılıç)
- Understanding the work of mathematics teacher educators: A knowledge in practice perspective (Wenjuan Li and Alison Castro Superfine)

Faculty cooperation and near peers were shown as playing vital roles to make rich field experience (Doğan & Kılıç, and Eriksen et al.). The prospective teachers' learning opportunities for teaching to diverse students were found not homogenous even within a country (Çelik et al.). Four practices by the teacher educators were identified as they connect preservice teachers' learning to the practice of teaching mathematics to students (Li & Superfine).

Theme 5: Developing Ability to Notice

This theme is about prospective teachers' developing their ability to notice. The following presentations were offered under this theme:

- Learning to act in-the-moment: prospective elementary teachers' roleplaying on numbers (Caroline Lajoie)
- The role of writing narratives in developing pre-service primary teachers noticing (Pere Ivars and Ceneida Fernández)
- Noticing and deciding the "next steps" for teaching: a cross-university study with elementary pre-service teachers (Dittika Gupta, Melissa Soto, Lara Dick, Shawn Broderick and Mollie Appelgate)

The sessions provided multiple perspectives on the ability to notice and the development of that ability amongst prospective teachers. The analysis of a role-play with pre-service primary school teachers involving the use of a calculator has been used to illustrate the complexity of learning to notice and learning to act

in-the-moment (Lajoie). Writing narratives have been used as a successful way to help pre-service teachers develop their skill of noticing pupils' mathematical thinking (Ivars and Fernández). Pre-service teachers' skills to recognize, identify and make instructional decisions have been examined in a context in which they were provided with opportunities to engage in noticing practices (Gupta et al.).