

# Preface

This volume is situated in the important area of research that investigates issues related to the mathematical education of pre-service elementary teachers (e.g., Chapman and Shuhua 2017; Lin and Acosta-Tello 2017; Song 2017). This area has attracted significant attention internationally for different reasons. One reason relates to the crucial role that elementary teachers have in setting the foundations for students' future learning of mathematics (e.g., Ball 1993; Kaput et al. 2007; Schifter 2009; Stylianides 2016). Another reason relates to the difficulties that many elementary teachers face with different mathematical concepts and the counterproductive beliefs they have about mathematics (e.g., Stylianides and Stylianides 2014; Wu 2017). A third reason for which the mathematical education of pre-service elementary teachers matters greatly is that it is during this period that pre-service teachers begin to form a basis of their future and ongoing quest about their expertise in mathematical instruction (e.g., Ma 1999; Jacobs and Spangler 2017; Li and Kaiser 2011).

The volume examines new trends and developments in research related to the mathematical education of pre-service elementary teachers, and explores the implications of these research advances for theory and practice in teacher education. It is organized around the following four overarching themes. Each theme includes four main chapters and a concluding chapter acting as a commentary on the theme overall. Although several chapters address issues that span across themes, practical considerations related to the organization of the volume necessitated a best-fit approach.

- *Theme 1:* Pre-service teachers' mathematics-content and mathematics-specific pedagogical preparation (Chaps. 1–5);
- *Theme 2:* Professional growth through activities and assessment tools used in mathematics teacher preparation programs (Chaps. 6–10);
- *Theme 3:* Pre-service mathematics teachers' knowledge and beliefs (Chaps. 11–15); and
- *Theme 4:* Perspectives on noticing in the preparation of elementary mathematics teachers (Chaps. 16–20).

We will not say much about the content of the four themes as the commentary chapters connected to each theme (Chaps. 5, 10, 15, and 20, respectively) provide an in-depth discussion of the four main chapters in the theme and identify issues/ideas that emerge from the entire collection. In brief, the chapters in Theme 1 emphasized the importance of tasks to promote professional growth (Chap. 1), explored pre-service teachers' knowledge of mathematics-specific domains such as proportional reasoning (Chaps. 2 and 3), and examined the role of computer technology in geometry (Chap. 4).

The chapters in Theme 2 presented current and emerging challenges related to elementary education programs. The mathematical background and related program experiences of pre-service teachers in the United States were analyzed to illustrate some of the issues for preparing elementary school teachers (Chap. 6). Effective characteristics of learning environments were discussed through prospective teachers' activities of designing nonroutine mathematical problems (Chap. 7). The pre-service teachers' procedural and conceptual knowledge of fractions were assessed and found to be in need of more attention in teacher education programs (Chap. 8). Simulation assessment was designed to reveal pre-service teachers' eliciting and interpreting capabilities that are crucial aspects of interactional practice of teaching (Chap. 9).

The chapters in Theme 3 provided different approaches to the mathematical knowledge and beliefs for teaching. They investigated mathematical knowledge for teaching and evaluation in the particular domain of argumentation (Chap. 11), explored self-efficacy as it relates to pre-service teachers' mathematical backgrounds (Chap. 12), considered different measures of knowledge and beliefs including teachers' beliefs for topic-specific knowledge (Chap. 13), and examined prospective teachers' learning opportunities for teaching to diverse sets of students (Chap. 14).

The chapters in Theme 4 provided multiple perspectives on the ability to notice and the development of that ability amongst prospective teachers. The analysis of a roleplay activity with pre-service elementary school teachers involving the use of a calculator was used to illustrate the complexity of learning to notice and learning to act in the moment (Chap. 16). Writing narratives was used as a successful way to help pre-service teachers develop their skill of noticing students' mathematical thinking (Chap. 17). Pre-service teachers' skills to recognize, identify, and make instructional decisions were examined in a context in which prospective teachers were provided with opportunities to engage in noticing practices (Chap. 18). Finally, three practices by the teacher educators were identified as they connect pre-service teachers' learning to the practice of teaching mathematics to students (Chap. 19).

We will say a few words now about how the volume came about. The volume includes a selection of expanded and improved versions of papers presented at the 13th International Congress on Mathematical Education (ICME 13) in Hamburg (Germany, 2016), under the auspices of Topic Study Group 47 (TSG 47) titled the "Pre-service Mathematics Education of Primary Teachers". The two of us were the cochairs of TSG 47 and we shared the responsibility of the organization of the TSG

activities with three other team members—Katja Eilerts (Germany), Caroline Lajoie (Canada), and David Pugalee (USA)—all of whom are involved in this volume, either as authors or commentators.

The 16 main chapters in the volume were selected from a total of 66 contributions to TSG 47 in ICME 13. Based on the review process we followed in our TSG, the 66 contributions were divided into different categories depending on how highly they were rated by other participants and members of the organizing team. The most highly rated contributions comprised 19 regular presentations, each of which included an 8-page paper. We invited the authors of those 19 papers to contribute an improved and expanded version of their paper as one of the main chapters in the volume. Sixteen of these author teams accepted our invitation and, following at least two rounds of review, each of those papers was accepted for publication in the volume. The four commentary chapters are written by internationally acclaimed scholars we invited based on their expertise on the corresponding theme.

In summary, the volume includes contributions from researchers working in 11 different countries and offers a forum for discussion of and debate on the state of the art related to the mathematical preparation of pre-service elementary teachers internationally. In presenting and discussing the findings of research conducted in different countries, the volume offers also opportunities to readers to learn about teacher education practices used around the world, such as innovative practices in advancing or assessing teachers' knowledge and beliefs, similarities and differences in the formal mathematics education of teachers, types of and routes in teacher education, and factors that can influence similarities or differences.

Last but not least, we wish to thank all the participants of TSG 47 in ICME 13 for their contributions and especially the chapter authors, the reviewers, and commentators for their constructive feedback and insights, and the Monograph Series Editor (Gabriele Kaiser) for her support throughout the preparation of this volume.

Oxford, UK  
Utsunomiya, Japan

Gabriel J. Stylianides  
Keiko Hino

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