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Understanding and enhancing teachers' knowledge for teaching mathematics

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This is my final editorial as editor-in-chief of the Journal of Mathematics Teacher Education (JMTE). It has been a privilege to serve the international community in mathematics education and contribute to the discipline of mathematics teacher education in this role. It is my pleasure to hand over to my colleague, Professor Despina Potari, who has served the journal for many years, first as a member of the editorial board, then as an associate editor during my term. Her research focus on mathematics teacher education also positions her to continue to develop and lead the journal in meaningful ways.

Research in mathematics teacher education has grown significantly over the life of JMTE and has contributed to the healthy state and continued high standard of the journal. Articles in JMTE have addressed a variety of topics that add scope and depth to the areas of research on the mathematics teacher. These areas include two interrelated strands of studies: (1) prospective mathematics teacher education and practising mathematics teacher professional development, which include the programs, tools/tasks, and processes used to support the teachers' learning. (2) Prospective and practising mathematics teachers' characteristics that include their mathematics-related beliefs, conceptions, and identity; mathematics knowledge; mathematics knowledge for teaching; pedagogical mathematics knowledge; and practice. In these studies, the participants being studied are mathematics teachers, defined broadly to include teachers of kindergarten to grade 12 mathematics, postsecondary instructors of mathematics, and mathematics teacher educators. Despite the large body of literature that now exits on mathematics teacher education, the fact that reform perspective (e.g., National Council of Teachers of Mathematics [NCTM] 2000, 2014) of teaching and learning mathematics is still not the norm in classrooms suggests the need for ongoing research in this field to inform teacher education in order to support teacher change/growth and the need for the role of JMTE in providing a means for disseminating rigorous and high-quality studies.

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In this issue of JMTE, the four articles provide a sample of the scope of the journal and the field in relation to their foci on the teacher and on supporting teacher learning and change. They represent three regions internationally, include both prospective and practising teachers, cover primary and secondary school levels, and deal with both teachers' knowledge or thinking and teacher learning. While three of the articles deal with topics that have been receiving ongoing attention in the field, (i.e., noticing and lesson study), they do add to our understanding of these topics in relation to teacher education and professional growth. The fourth article, however, addresses the topic of culturally responsive teaching and cultural awareness that perhaps needs more attention given the growing diversity of classrooms in many countries. As the NCTM's (2000) equity principle states:

> Excellence in mathematics education requires equity–high expectations and strong support for all students. (…) Equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students. (p. 12)

To achieve this, teachers need to hold knowledge of their students beyond the content that provides appropriate context to engage them meaningfully in the mathematics classroom and the learning of mathematics. This article draws our attention to the cultural dimension of this knowledge.

The two articles on *noticing* provide further evidence of the importance of this topic to teacher education. María Luz Callejo and Alberto Zapatera's article addresses prospective primary school teachers' noticing of students' understanding of pattern generalization, while Amber Simpson and Leigh Haltiwanger's article addresses prospective secondary school mathematics teachers' noticing of students' mathematical thinking. The other two articles offer different approaches to support teachers' change. While Wanty Widjaja, Colleen Vale, Susie Groves, and Brian Doig's article addresses primary school teachers' professional growth through engagement with lesson study, Frieda Parker, Tonya Gau Bartell, and Jodie Novak's article addresses the professional development of secondary school mathematics teachers through the use of projects. The following abstracts of these studies highlight their contributions to these areas of mathematics education.

Callejo and Zapatera's study aimed to characterize profiles of prospective primary school teachers' noticing of students' mathematical thinking in the context of pattern generalization. The 38 participants in a mathematics education course in Spain were first asked to solve three linear pattern generalization problems in which a series of figures that follow a pattern of additive growth were introduced. They received support as needed to address any difficulties. Later, they were asked to describe and interpret the responses of three primary school students to the same problems and to propose what actions to take. They were given no information on primary school students' understanding of pattern generalization. Based on the researchers' definition of three stages of how students generalize pattern, the findings indicated five profiles that are hierarchical and differentiated by the degree of competency of the participants in interpreting the students' understanding. For the lowest level profile, the participants showed no evidence of interpreting any degree of student understanding, for the intermediate levels they interpreted understanding of one or two stages, and for the highest level they interpreted understanding of all three stages. While they named various mathematical elements to describe the students' answers, they did not always use them to interpret the understanding of pattern generalization of each student.

In their study on noticing, Simpson and Haltiwanger **e**xamined how prospective secondary school mathematics teachers made sense of students' mathematical thinking and what they perceived to be their strengths and weaknesses in doing so. The 30 participants, in an education program in the USA that did not formally include professional noticing, were provided with three representative student work samples that involved a search for a pattern with the aid of a table, using a visual approach, or using an additive approach. They were required to attend to, interpret, and respond to the students' thinking and respond to three open-ended questionnaire prompts for each. The prompts involved describing their thinking of what each student did, explaining what they learned about the student's understanding, and suggesting what problem or problems they might pose next and why. Findings indicated that in interpreting students' mathematical thinking, most of the participants focused only on what the students did understand and did not consider what they did not understand. They compared the students' approaches and/or perceived mathematical thinking to their own approaches and mathematical thinking to solve the problem. Their self-identified strengths and weaknesses compared to their professional noticing scores revealed that they rated their confidence in understanding students' work differently and that some rankings were not inline with their professional noticing scores. A majority explained that the basis for their ranking and difficulty in understanding students' work were due to lack of relevant experiences and confidence.

While the preceding two articles focus on prospective teachers and their competence regarding noticing of students' thinking, the following two articles focus on practising teachers and their learning through different approaches to impact their thinking and practice.

Widjaja et al.'s study investigated teachers' professional learning experiences and growth in implementing structured problem-solving mathematics lessons through a lesson study project. The ten participants, consisting of primary school teachers and numeracy coaches from three schools in an Australian local school network, participated in a lesson study project over two research cycles. Findings, reported for a team of three of the teachers, indicated that they initially believed that their students could not find efficient solutions, problem-solving lessons enabled differentiated learning as students could choose their solution strategies, and individualized teaching caters for differentiation. Their changed beliefs included that their regional lesson structure could be adapted to include extended, orchestrated whole-class discussion and to explicate the learning intentions at the end rather than the beginning of lessons and that some students could generalize from patterns. They showed increased attention to students' mathematical thinking and use of orchestrated whole-class discussion based on anticipated student solutions and focused questioning. They also learned to value planning for anticipated solutions and focusing on questions to probe student understanding and became aware of different strategies to cater for individual differences. In addition to the collaboration and reflection throughout the lesson study cycles, critical elements impacting change included an adapted Japanese problem-solving lesson structure, reflection on unanticipated student responses, and a mix of people from different schools.

In their intervention study, Parker et al. explored how teachers' perceptions about the role of culture in knowing and being responsive to students changed as a result of taking the "Culture in the Mathematics Classroom" graduate course in the USA. The purpose of the course was to help secondary school mathematics teachers to develop the knowledge and skills to grow their capacity for culturally responsive teaching. Culturally responsive teachers have particular attitudes, beliefs, and practices that inform how they know students. The 13 participants engaged in four course projects: "does culture matter" project,

"community engagement" project, "cultural inquiry process" project, and "motivation" project. Findings indicated that the teachers' perceptions of cultural awareness and cultural responsiveness changed in relation to culturally responsive teaching. Their understanding of what culture is and how it might influence students' engagement in school was most influenced by the "does culture matter" project which was designed to introduce them to different perspectives on the role of culture in mathematics education. In this project, they read vignettes involving: ways students experience discord with the norms of schooling that can interfere with learning, the role and purpose of mathematics education, cultural values and ways of understanding, and out-of-school mathematical practices. These vignettes, situated in mathematics education, seemed particularly helpful for teachers to reflect on cultural awareness.

The four articles offer specific suggestions regarding implications for teacher education and research. For example, Callejo and Zapatera suggest that their study offers examples of tasks, profiles of noticing, and transition among profiles that could be useful for understanding and supporting the development of prospective mathematics teachers' expertise in identifying and interpreting students' answers. Simpson and Haltiwanger hypothesized that increased, targeted opportunities to analyze and make sense of students' mathematical thinking have the potential to boost participants' confidence and their abilities in understanding students' mathematical thinking. Widjaja et al. suggest that investing in in-depth, quality planning, with a focus on advancing students' thinking and building teachers' capacity for implementing structured problem-solving lessons through lesson study, lead to teachers' professional growth. Parker et al. suggest that exploring vignettes as used in their study may be especially important for secondary school mathematics teachers who tend to view mathematics as culture free. They also note that their analytic framework of cultural awareness and cultural responsiveness may be a useful tool for describing different dimensions of what teachers need to know about culturally responsive teaching.

In general, these articles provide further evidence of the importance to help prospective teachers to develop competency in noticing and making sense of students' mathematical thinking and the type of changes in teachers' beliefs and knowledge for teaching mathematics that can be achieved with appropriate professional development experiences. They now become part of the large body of research JMTE has made available to the growing field of mathematics teacher education.

I end with gratitude to my professional colleagues for their contributions as associate editors, guest editors, editorial board members, and reviewers to JMTE during my term as editor-in-chief. My sincere thanks to the current associate editors, Kim Beswick, Salvador Llinares, Gwendolyn Lloyd, and Despina Potari, and previous associate editors, Anne Cockburn, João Pedro da Ponte, and Margaret Walshaw for their invaluable support. I also thank the guest editors of past special issues [Issues 15(1); 18(5); 19(2–3)] and the two special issues almost completed (*Videos as a catalyst for mathematics teachers' professional growth*; *Mathematics teacher educators' knowledge*) for their valued contribution in making these issues possible. Thanks to the editorial board members and the many reviewers for their helpful reviews that contributed to the ongoing high standard of the journal.

References

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: NCTM.
National Council of Teachers of Mathematics. (2014). *Principles to actions*. Reston, VA: NCTM.