Editorial

Taking Stock: *MTE*'s Contribution to Building a Knowledge Base for the Practice of Mathematics Teacher Education

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When you link to **http://www.nctm.org/Publications/mathematics-teacher-educator/About-Mathematics-Teacher-Educator/** to learn about writing a manuscript for publication in Mathematics Teacher Educator (*MTE*), one aspect of the call for manuscripts that likely stands out is the importance of informing the *practice* of mathematics teacher education. This directive in the call raises questions such as *What* is meant by "practice" in the *MTE* call, considering Lampert's (2010) unpacking of the various ways scholars use this term when talking about teaching? *Why* do we need work that speaks to the practice of mathematics teacher education? *How* is mathematics teacher education a *practice*? Over a decade ago, scholars fervently debated whether teaching, more broadly, is a practice (see Noddings, 2003) and, certainly, the issue is not yet settled. Meanwhile, the demand facing mathematics teacher educators to better educate teachers means more support is needed for those doing the work; mathematics teacher educators continue to face increasing pressure to prepare teachers to engage in more "ambitious teaching" (Newmann & Associates, 1996) than what was expected nearly three decades ago.

To illustrate what I perceive as a great need for work that addresses the practice of mathematics teacher education, in the sense of practice as "carrying out" the work of preparing mathematics teachers (Lampert, 2010), I offer a story from my own experience in becoming a mathematics teacher educator as one that likely resonates with many. I still remember vividly about 10 years ago, as a graduate student, I was preparing to teach my first course on the pedagogy of secondary mathematics with prospective teachers. I had been well supplied with syllabi from former instructors, and I had shadowed another educator teaching the class as a small qualitative study for a course project. But I was panicking; I went into a professor's office and said, simply, "I think I know some things about how to teach mathematics, but I don't know how to teach other people how to teach mathematics." I felt I had few resources to understand the perspective of the beginning teacher or how to share my knowledge and experience in an educative way. It was, in some ways, a productive frame of mind; I recognized my own nascent understanding of teaching prospective teachers and tried to channel that when I imagined their reactions to course material. But, I desperately needed *tools* for supporting the complex work of helping novices teach in ways that were responsive to the needs of students.

Now, as associate editor of *MTE*, my understanding of mathematics teacher preparation has grown, and I have *MTE* as an amazing resource for my practice as a mathematics teacher educator. To ascertain the extent to which *MTE* is now a resource for building the knowledge base of the practice of mathematics teacher education, the editorial team—Sandra Crespo, graduate assistants José Martínez Hinestroza and Amanda Opperman, and myself—conducted a comprehensive analysis of the keywords used by authors to index their manuscripts since the inception of the journal. These keywords act as searchable, low-tech "hashtags" and, thus, are a shared language that teacher educators use to broadcast to other teacher educators about their work. While authors cannot include more than five keywords and are limited by the range of keywords they can use to describe the manuscript, this analysis can, nonetheless, help us see how *MTE* has contributed to the knowledge base of the practice of mathematics teacher education.

Before diving into what we learned, let's consider whether we can even call mathematics teacher education a *practice*. Alasdair MacIntyre, in dialogue with Joseph Dunne (see MacIntyre & Dunne, 2002), claimed that teaching is not a practice in the way that portraiture is a practice or medicine is a practice. Here, MacIntyre is defining "practice" as a "complex form of socially established co-operative human activity" that has "standards of excellence" to mark a continuum of excellence in doing the practice and both "external" and "internal" ends that serve to benefit the practitioner as well as, but not necessarily at the same time as, society (p. 7). At the core of this argument is the assumption that teaching is only a means by which students learn disciplinary practices, so teachers act as agents of those disciplines (and, thus, the best teachers are the ones that have strong disciplinary knowledge).

Noddings (2003) rebuffed MacIntyre's argument with a claim that, although teaching is a means-oriented activity, it is hardly different from the work of physicians as a means to achieve wellness for a patient. Like medicine,

teaching is a culture where practitioners engage in some shared practices (Lampert, 2010) for the advancement of students and society. Noddings further asserted that teaching has "its own distinctive criteria for internal excellence" (p. 251). Part of this criteria for internal excellence is the broad cultural knowledge that teachers must use, unlike mathematicians and physicians, to notice and elicit ideas from learners from a variety of backgrounds and respond to their thinking in ways that motivate and address the needs of their primary constituents (students). This is at the core of being a "relational" practice; teachers exert care to ensure that learning is accessible to their students.

So, if mathematics teacher education is the act of teaching others about teaching mathematics, then, according to Noddings (2003), mathematics teacher education is a relational practice where practitioners are expected to have broad cultural knowledge of mathematics education. This broad cultural knowledge includes knowledge of learning theories, disciplinary content, school settings, professional standards, approaches to teaching, factors that affect students' opportunities to learn, and so forth. However, one challenge for our field is that the "culture of teaching is not homogeneous" (Lampert, 2010, p. 29). Our practice is shaped by the context in which we are engaged in teaching, and our knowledge of this context is a part of the broad cultural knowledge we need and a part of how we consume scholarship on the practice of mathematics teacher education. Thus, as *MTE* asserts its role as building the body of knowledge related to the *practice* of mathematics teacher education, the articles published in the journal must address the development of mathematics teacher educators' knowledge across the spectrum of topics related to the work of teaching in schools while situating that knowledge as relative to the contexts of teacher education.

To unpack how *MTE* has informed the practice of mathematics teacher education thus far, we started by making a list of all articles published from the inception of the journal through the November 2015 issue (n = 36). We then noted the keywords selected by the authors for each article, separating keywords into two classes. One class comprised keywords that flag the teacher education *context* of the work (e.g., elementary, teacher preparation, professional development). The other class comprised keywords that highlight the *topic* of the work as known within the field (e.g., sociomathematical norms, teacher knowledge, English language learners). For the topic class, we consolidated keywords into categories. For instance, we categorized keywords such as "proportional reasoning" or "linear relationships" as *mathematical content*. We also expanded our search to include the nouns used in the titles and abstracts of the articles relevant to topics and contexts of mathematics teacher education. This analysis added two categories—*Connections beyond school and Model of teacher preparation or in-service PD*—to the list. The full list of 12 categories, which included *assessment*, *discourse*, *diversity/equity/language*, and *teachers' knowledge*, can be found in Table 1. Please note that multiple keywords from a single article may

Table 1
Keyword Categories and Examples

Keyword category	Example keywords
Teachers' knowledge	Statistical knowledge for teaching, teacher knowledge, mathematical knowledge for teaching
Mathematical content	Geometry, rate of change, proportional reasoning
Discourse	Classroom discourse, orchestrating classroom discussions
Mathematical practices and processes	Argumentation, mathematics practices
Diversity/equity/language	Multicultural, English language learners
Technology	Clicker technology, video and teacher learning
Teacher noticing	Noticing
Methods of research	Improvement science, action research
Assessment	Mathematics assessment, formative assessment
Students' thinking and reasoning	Concept image, children's mathematical thinking
Connections beyond school	Family-school partnerships
Model of teacher preparation or in-service PD	Simulations, model teaching, professional learning communities

have fit into one category, such as "function," "quantitative reasoning," and "rate of change" all being categorized as *mathematical content*.

Our analysis of context-related keywords revealed that the articles featured in *MTE* tend to reflect issues related to the practice of prospective teacher education (25 articles) more than in-service teacher education or professional development (11 articles). Of the articles related to prospective teacher education, the vast majority addresses issues in "methods" or courses related to mathematics pedagogy than mathematics content courses for prospective teachers. More articles appear to be focused on K–8 prospective teacher education (n = 15), whereas articles related to in-service teacher education are fairly split between different grade bands.

The heart of the analysis was a closer look at the keywords assigned to categories related to topics of interest to the field (see Table 1). Perhaps not surprising given the continued interest in the construct known as *mathematical knowledge for teaching* (Ball & Bass, 2000), the categories *teachers' knowledge* (n = 10) and *mathematical content* (n = 9) were the most prevalent categories of keywords across the articles. Looking into the results for the category *mathematical content*, geometry, algebra (including functions), and number and operations were fairly equally dispersed among both prospective and in-service mathematics teacher education articles listing such keywords. The keywords coded as *teachers' knowledge* were less specific; the most prevalent keyword was "mathematical knowledge for teaching." We also constructed a pivot table within Excel to determine if there were any patterns of particular keywords frequently listed together. Again, the results are not too surprising; there were six instances of keywords related to *teachers' knowledge* that also appeared with a keyword related to *mathematics content* in the keyword list. Keywords related to *mathematical practices and processes* frequently appeared with keywords related to *discourse* and *mathematical content*.

The breadth of the topics spanned in the categories affirms the claim, based on Noddings' (2003) assertions, that mathematics teacher education is a relational practice that calls practitioners to have breadth of knowledge about mathematics, students, teaching in schools, and schooling. Thus far, the work published in *MTE* tends to focus on our efforts as mathematics teacher educators to develop the knowledge of elementary mathematics educators, primarily at the preservice level. This work is attending to knowledge related to pedagogical practices that are powerful for shaping productive opportunities for students to learn mathematics (e.g., discourse moves, noticing students' thinking). We can also consider these keywords in light of policy recommendations and calls for reform, such as those provided in *The Mathematical Education of Teachers II* (MET II) report (American Mathematical Society, 2012) and *Principles to Actions* (NCTM, 2014).[1] Some notable areas of these reports being addressed by *MTE* articles include the prevalence of keywords related to justification, proof, and argumentation (n = 8) as responsive to Recommendation 2 from the MET II (coursework for prospective teachers should allow time to engage in reasoning, justification, and sense-making). Additionally, *MTE* articles have featured research on a number of mathematics teaching practices highlighted in *Principles to Actions* (NCTM, 2014), namely "facilitate meaningful mathematical discourse," "elicit and use evidence of student thinking," and "use and connect mathematical representations" (p. 3).

However, when thinking about the broad cultural knowledge needed to be effective mathematics teacher educators, it is surprising that there are relatively few articles related to developing teachers' understanding and practices related to assessment, educating emergent bilingual learners, using technology, and other such aspects of teaching practice that are salient to the work of today's mathematics teachers. All of these topics are also noted as core mathematics teaching practices in *Principles to Actions* (NCTM, 2014). Further, relatively few papers have featured work within the contexts of content courses for teachers—a context where, as indicated in the MET II report (2012), we need to learn more about productive collaborations between mathematicians and mathematics teacher educators to promote opportunities for all prospective and in-service teachers to deepen their content knowledge for teaching.

There are clear limitations in defining the body of knowledge in *MTE*'s volumes by an analysis of keywords and nouns in article titles and abstracts. While our keyword analysis suggests several areas where more work is needed, the results also raise the question of whether we, as mathematics teacher educators, are using our keywords, titles, and abstracts to best highlight the contributions of our work to the knowledge base for the practice of mathematics teacher education. Think about the last Google Scholar search you initiated. My hunch is, assuming you have some prior experience conducting searches for literature, that you consciously chose not to enter terms such as "elementary teacher preparation" or "mathematical knowledge for teaching" because they would

1 In 2015, there was a call for manuscripts focused on *Principles to Actions* (NCTM, 2014) as it informs teacher education. Upcoming issues will present papers that responded to this call and directly address recommendations from *Principles to Actions*.

yield a less-defined output than desired. Sage Publishing is one of several publishers who have offered some advice for making your article accessible to those searching in your field (see **https://us.sagepub.com/en-us/nam/help-readers-find-your-article**). Among the tips they provide are recommendations for choosing titles and keywords carefully, as titles and keywords are among the few parts of the text of your article that search engines account for in their algorithms. One strategy for selecting keywords is to look for key phrases that emerge in your abstract and title, and repeat those phrases as keywords or select the closest match from a publisher's provided list of keywords. And, it doesn't hurt to ask yourself, What keywords would I type into a search engine to find my article?

This *MTE* issue features articles with following keywords: definitions, eliciting student thinking, learning trajectories, noticing student thinking, pedagogies of practice, professional development, secondary methods, student interviews, teacher education, teacher learning, and whole-class discussions. These keywords illustrate that these articles are building knowledge in an impressive array of topic areas in mathematics teacher education. In this set, we see keywords that relate to categories *mathematical content*, *teacher noticing*, *teacher knowledge*, *discourse*, *models of teacher preparation*, and *students' thinking and reasoning*. Among this set, the keywords "definitions," "learning trajectories" and "pedagogies of practice" emerge as new topics within the categories *mathematical content*, *students' thinking and reasoning*, and *models of teacher preparation or in-service PD*, respectively.

The first two articles (authors Baldinger, Selling, and Virmani and authors Lesseig, Casey, Monson, Krupa, and Huey) address, respectively, findings related to the implementation of instructional activities to promote prospective teachers' practices for leading whole-class discussions and developing student interview assignments that enhance prospective teachers' noticing of student thinking. Baldinger and colleagues illustrate a case of employing an instructional activity within the cycle of enactment and investigation—a signature pedagogy of practice-based teacher education—to specifically build secondary prospective teachers' understanding of facilitating a discussion toward a mathematical point. Their work not only offers mathematics teacher educators a particular instructional activity they can use in their courses but also builds on a growing body of literature in the field that is providing a shared language to talk about aspects of the high-leverage practice of facilitating whole-class discussions (Lampert, Beasley, Ghousseini, Kazemi & Franke, 2010; McDonald, Kazemi & Kavanaugh, 2013). Similarly, Lesseig, Casey, Monson, Krupa and Huey provide an empirically tested model for enacting student interviews as an activity to develop prospective teachers' eliciting and use of student thinking. Building from other work published in *MTE* on the use of the clinical student interview as a signature activity in early field experiences (see Fernandes, 2012), Lesseig and colleagues' study adds to our understanding of technique to support the enactment of the activity as well as presents a case for how to integrate research on students' mathematical thinking (in this case, the Rule of Four Model for Multiple Representations) as a means to support prospective teachers' analysis of student thinking. The authors provide in appendices to their article particularly helpful rubrics to show how research can be made usable for prospective teachers. In another article related to the work of secondary teacher preparation, Teuscher, Switzer, and Morwood contribute to the growing body of knowledge on developing prospective teachers' abilities to notice and probe student thinking by sharing their work as mathematics teacher educators to unpack the practice of probing student thinking with their secondary prospective teachers. One notable aspect of this piece is their carefully detailed account of their process to study their practice as mathematics teacher educators, and how their scholarship of teaching taught them about the importance of making their tacit knowledge about the practice of probing student thinking more explicit for the prospective teachers in their courses. Their article also offers a framework for other mathematics teacher educators to use that provides prospective teachers with opportunities to unpack and study the practice of probing student thinking.

This issue closes with an article by Edgington, Wilson, Sztajn, and Webb that offers a conceptualization of mathematics teacher educators as translators of mathematics education research for teachers. They describe the process of turning a synthesis of four learning trajectories (LTs) on number and operations into an accessible boundary object (Wenger, 1998) for mathematics teachers to use to plan and enact instruction. The article focuses on their work in the context of PD for elementary teachers, yet the combination of their careful accounting of the PD enactment and their use of the LT Profile Table as an artifact for collective reflection in the PD provides insight into how research can be translated into practice by mathematics teacher educators.

As a collective set, these four articles not only advance the work of the *MTE* journal to contribute to the practice of mathematics teacher education in key areas (e.g., secondary teacher preparation, learning trajectories, probing student thinking, in-service PD, and use of instructional activities in teacher education), but they all provide excellent examples of how to document our practice as mathematics teacher educators for our collective study

and reflection. Thinking back to the first secondary mathematics "methods" course I taught with prospective teachers, where I attempted activities like clinical interviews and microteaching, I would have benefited from the insights of these articles in developing both the design of the activities and my understanding about prospective teachers' conceptions as they learn to teach with these activities. This exercise in "taking stock" of the scholarly contributions in *MTE* to the knowledge base on the practice of mathematics teacher education has shown the impressive breadth of *MTE*'s contributions thus far, and we hope you look forward to each issue as much as we enjoy publishing it.

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