Chapter 3.3
Public Writing in the Field of Mathematics Teacher Education

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Mathematics teacher education can be seen as directly related to activity in mathematics classrooms and the success (or other) of students learning mathematics worldwide. In what ways does what is published in the field of mathematics teacher education inform us about key question and issues, about programmes for educating teachers, and about research findings? We refer specifically to an International Congress on Mathematical Education (ICME) survey (with Adler as chair) and to the *Journal of Mathematics Teacher Education* (JMTE), the leading journal in the field (with Jaworski as editor in chief).

1. Defining the Scope and Nature of the Field: an Icme 10 Survey

In July 2004, an international team of five mathematics educators and researchers presented the results of their survey of research in mathematics teacher education from 1999 to 2003, during a plenary session at ICME 10, in Copenhagen. The details of the survey have since been published in *Educational Studies in Mathematics* (November 2005), and the authors conclude that the survey provides a vantage point from which to reflect on the current state of the field of mathematics teacher education research.

Briefly, the survey included published research in international mathematics education journals, international handbooks of mathematics education, and international mathematics education conference proceedings. Some regional sources from various parts of the world were also included. The investigation focused on who was writing, from and in what settings, with what theoretical frameworks, and with what sorts of study designs for what core questions. The range of findings and conclusions produced in these studies were also examined. Four themes stood out from the initial investigation of almost 300 published papers. These themes were then systematically elaborated through a focused study of a 160 papers across two key journals in the field (*JMTE* and the *Journal for Research in Mathematics Education* [JRME]) and a key set of conference proceedings (*Psychology of Mathematics Education* [PME]). Four substantive claims were made, evidenced, and commented on from different perspectives. Here we summarise rather than debate these claims.

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Claim #1: Small-scale qualitative research predominates. The authors clarify that by small-scale qualitative research they include research that focuses on a single teacher or on small groups of teachers (n<20) within individual programmes or courses. They explain that the systematic analysis of the 160 papers referred previously revealed that there were fewer than 20 teachers in close to 70% of the studies reported. In short, a significant percentage of papers surveyed were small case studies.

Claim #2: Most teacher education research is conducted by teacher educators studying the teachers with whom they are working. In addition to most studies being small case studies, the survey also revealed the phenomenon of what some would call "insider" research—where researchers have some direct involvement and thus some interest in the case being studied. Of articles representing research that focuses on teacher education between 1999 and 2003, 90% of *JMTE*, 82% of *PME*, and 72% of *JRME* articles were of this type.[1]

Claim #3: Research in countries where English is the national language dominates the literature surveyed. The following figures were presented to substantiate this claim. In *JMTE* between 1998 and 2003, 80% of the articles are from such countries. In *JRME* this figure is 71%. It is less stark, but nevertheless prevalent, in *PME* between 1999 and 2003, when the percentage is 43%. One effect posited was that questions that come to constitute the research field are driven by concerns in particular contexts and thus might not reflect the diversity of problems in teacher education that exist globally. This was a controversial and contested claim, both at the ICME 10 Congress after the presentation, as well as during discussion after our presentation at the 15th ICMI study conference. The objection was that this is self-evidently skewed by the journals and conference proceedings focused upon, as these were English-language journals. We will not take the debate further here but rather ask: are the questions that drive mathematics teacher education research appropriate across diverse cultural contexts and conditions?

Claim #4: Some questions have been studied extensively, while other important questions remain unexamined. The survey noted that much of the research, particularly in the United States, was concerned with reform and involved efforts to show that particular programmes of teacher education "work". As a field, we are more informed about teachers learning or relearning mathematics, teachers learning about students' thinking, their language, their orientations, and pedagogical practices. As a consequence of the focus on reform, however, we know much less than we should about teachers' learning from experience: what they learn, whether they learn, and what supports learning from experience. We also know too little about teachers' learning to directly address inequality and diversity within their teaching of mathematics, and we lack comparisons in the field of different opportunities to learn. Finally, we have done much less studying of what it means to scale up a programme or extend a programme that has worked in one setting to another setting.

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[1] As there were only seven *JRME* papers between 1999 and 2003 that fit our survey, this percentage can only be regarded as a very rough measure.

2. The Journal of Mathematics Teacher Education

It seems clear from reports from the survey that *JMTE* is an important publishing resource in our area. Its mission statement reads as follows:

> The Journal of Mathematics Teacher Education is devoted to research into the education of mathematics teachers and development of teaching that promotes students' successful learning of mathematics.
>
> JMTE focuses on all stages of professional development of mathematics teachers and teacher educators and serves as a forum for considering institutional, societal and cultural influences that impact on teachers' learning, and ultimately that of their students.
>
> Critical analyses of particular programmes, development initiatives, technology, assessment, teaching diverse populations and policy matters, as these topics relate to the main focuses of the journal, are welcome.

JMTE is a young journal: at the time of this writing, the tenth volume had just been completed. The journal has an acceptance rate of 18% for research articles. The contents of *JMTE* are compiled mainly from submitted articles in two categories: accounts of relevant research and accounts of teacher education programmes around the world. The latter has been established to encourage publication from a wide range of countries. However, papers come mainly from the developed world, with a high proportion (>50%) from North America. Nevertheless, the journal invites papers from all countries and works hard to help non-English-speaking authors complete a paper in English. In addition, *JMTE* publishes special issues, either compiled from submitted papers that centre around one important topic area (an example was "community" in *JMTE* 6, 3) or a topic area proposed by a prospective guest editor and accepted by the editorial team (e.g., "Relations between theory and practice", *JMTE* 9, 2). Most recently, a special triple issue (*JMTE* 10, 4–6) was completed, focusing on the nature and role of tasks in mathematics teacher education.

In accordance with the survey, most research articles report small-scale qualitative research that comes largely from teacher educators researching their own practice. From the volumes so far we see evidence of a developing field from papers in which research provides evidence of individual teacher or small teacher group development within a particular programme;

- that a learning community exists or is developed;
- that teachers engage in critical inquiry, reflective practice, or action research;
- that a teacher education programme links closely with the practice field;
- of teachers and teacher educators working side by side in and out of school; and
- that teachers or student teachers learn from engagement in research.

In all cases there is evidence of deep learning and changes to practice. It is clear that such research both documents learning in practice and, in many cases, contributes to that learning. Editors and reviewers look for a suitably critical stance from authors reporting research into their own practices or programmes. Nevertheless, we should ask what endures and grows from these published accounts. What can take the field beyond the local and special-case nature of such research? How is it possible to generalise from such studies? What methodologies will provide larger-scale

evidence of teacher learning and developmental approaches that result in better teaching and learning? What theory can we see emerging from research in the field? There is a wide range of theoretical models or frameworks for developmental practice or to explain or analyse teacher and teaching development. However, there are, as yet, no "grand" theories to compare, for example, with theories of learning, such as constructivism or sociocultural theories. Indeed, attempts to distil guidelines for practice from learning theory have resulted in pseudo-theoretical appellations ("constructivist teaching" is one common example), which have no substance or credibility in the practical world.

Rightly, the world of practice expects more from research than can be seen currently; however, the nature and prevailing conditions of and for research militate against fulfilment of such expectations. Political short-termism, local and national, perpetuates the status quo: teacher educators are required to publish; large research teams are difficult to convene and fund; longitudinal studies are both expensive and, crossing different administrations, not always politically compatible. Developmental sustainability beyond the end of a project is accordingly difficult to enable. However, there are deeper issues in the field that we have to consider before changes in policy can be expected to change the developmental landscape.

3. Research Programmes

In response to the previous discussion, we end with a focus on two areas of research that are starting to address some of the key issues raised.

3a. Mathematics for Teaching

An interesting observation from the survey and an overview of *JMTE* is that in the current foci in mathematics teacher education research, the specificities of mathematics recede. Here we bring mathematics back into focus through a discussion of what elements of a research programme will take forward the field of mathematics teacher education research.

What mathematics is selected into mathematics teacher education courses and programmes, be these mathematic courses, or mathematics methods courses? How is this mathematics taught and evaluated and with what effects on teachers' (both prospective and practising) learning mathematics and mathematical know-how pertinent to the demands of teaching? Generally referred to as mathematics for teaching, there is now a growing interest in describing the specificity of the ways teachers need to know and be able to use mathematics effectively in their teaching and the opportunities teachers are provided for learning this situated or professional knowledge. There is a growing appreciation that this kind of mathematical focus and learning is left to the vicissitudes of practice. Just as we know that in school there are gaps between curriculum intentions, implementation, and attainment, we need to

acknowledge that even in programmes where there is a focus on what is becoming valued as mathematics for teaching, we need empirical studies on such, what comes to be learned, by whom, and with what effects. One such study (the QUANTUM research project), in South Africa, for example, has revealed a range of pedagogic modalities at work through a cross-case analysis of different sites of formalised in-service programmes. The ways in which mathematics and pedagogy are integrated differ across courses and provide different (and potentially inequitable) opportunities for learning mathematics for teaching (Davis, Adler, & Parker, 2007). Moreover, through a focus on assessment that mathematics courses specifically designed for formalised in-service teachers in these programmes rarely required teachers in these courses to demonstrate competence in reasoning mathematically neither in relation to a particular mathematical idea or concept nor in relation to how this might be done and so responded to by the teacher (Adler & Davis, 2006). We need to know a great deal more about the kinds of mathematical learning opportunities afforded in both formal and informal sites of teacher education so as to be able to improve the quality of teacher education, particularly in relation to what and how mathematics is selected, taught, and assessed.

3b. Research Partnerships Between Teachers and Educators

The survey and *JMTE* experience show the scarcity of long-term research programmes in which development can be studied. Setting this alongside a scarcity of research linking teacher education to the learning of mathematics in classrooms, a study in Norway, currently in its fifth year, offers potential significance. Here, teachers and educators (didacticians) work together to study development of mathematical learning activity in classrooms through the creation of inquiry communities. Both groups bring important knowledge and experience to the research interface that forms the basis of community; both engage in inquiry to introduce and explore innovative practices and challenge traditional classroom approaches. Original funding for four years from the Research Council of Norway has been extended to four more years, and the original team in one city and university has extended to five locations in Norway. At the end of the first four years, findings show significant development for individual teachers or groups of teachers in project schools and clear evidence of pupils' engagement in practices that motivate students and foster mathematical understanding. The locus of power in the early years has rested with didacticians, teachers taking time to find a voice and influence the directions of activity. Institutional and sociocultural factors also have dominated practices for teachers, often working against preferred practices within the project. More recently, schools have sought and attracted their own funding, and school leaders, together with didacticians, design activities and take responsibility for their operationalisation in institutional settings. In each of the five locations we see substantial teams of didacticians and a range of participating schools. Funding from the research council is matched by local funding from a range of sources. The scale of this research and the potential

it creates for development is a result of ambitious design, adequate (although not generous) funding, a sincere will to develop partnerships with shared power and responsibility and a long-term vision. In these respects the Norwegian research is addressing several of the concerns reported previously (Jaworski et al. 2007).

There seems to be a necessity for seeking out and reporting from projects that are starting to address the issues raised, particularly those with large-scale and long-term funding, as a basis for encouraging this longer-term vision.

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