LEARNING TO TEACH PRESERVICE MATHEMATICS TEACHERS: 
THE ROLE OF A DOCTORAL COURSE
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Abstract
The teaching preparation of mathematics teacher educators has not been an area of programmatic or systematic attention in doctoral programs of education, which most prominently focus on the content, discourse, and practices of educational research. Such inattention to the teaching development of teacher educators propagates the very same myths schools of education tend to challenge, such as 'experience is the best teacher.' This study investigated the experiences of 8 first and second year doctoral students in a ‘teaching practicum’ doctoral course designed to support their teaching of future teachers of mathematics and their development as mathematics teacher educators. The analysis of these experiences shed light on the study’s questions: what is involved in learning to teach future teachers of mathematics and what role does (or might) a doctoral course play in such learning?

Introduction
While challenges of learning to teach mathematics have been widely documented over the past two decades (see Ball, Mewborn, & Lubienski, 2001; Brown & Borko 1992), challenges of learning to teach future teachers have received much less attention. Challenges of teacher education have been explored broadly (e.g., Katz & Raths, 1992) and several endemic dilemmas have been identified, such as interplay between theory and practice, and programmatic coherence. Challenges of learning to teach future teachers has also been explored by individual teacher educators as they reflect on and study their own practices (e.g., Feiman-Nemser & Featherstone, 1992).

In light of such challenges, researchers (e.g., Heaton, 2000; Nicol, 1997) raise questions about the lack of attention to learning to teach prospective teachers in graduate schools of education. As a recent study of students’ experiences reports, 83% of doctoral students surveyed stated that, “enjoyment of teaching made them interested in being a professor” (Golde & Dore, 2001, p. 21). Yet, respondents also indicated that support for such work - organized and sustained professional development - varies greatly across institutions and within and across departments. Furthermore, as Golde and Dore note, it is not preparation for teaching that comprises a significant portion of graduate student work. Rather, preparation to conduct research tends to receive the greatest attention in courses, guided practica, and faculty-student interactions. Despite this, it is a widespread practice for graduate students to teach undergraduate preservice courses as part of their assistantships.

Concern for the teaching preparation in doctoral programs is also represented in a recent document that compiled mathematics educators’ discussions around preparation of doctoral students (Reys & Kilpatrick, 2000). In this document, Lambdin and Wilson (2000) stated that: “doctoral programs in mathematics education must ensure that students are involved in a variety of teaching experiences, both in schools and at the university level” (p. 82). The form, length, and number of such experiences, however, were not specified and were reportedly a point of disagreement among the mathematics educators at this retreat.

In response to concerns similar to those stated above, our Department of Teacher Education launched a programmatic effort to explicitly mentor graduate students into their roles as future teacher educators. Doctoral students, who are or will be teaching preservice teachers for the first time, are required to take a “practicum in teaching” course. The purpose of this study is to investigate the role such a course plays (and might play) in helping doctoral students learn to teach and to inquire into their teaching of future teachers of mathematics.

This study contributes to the scarce literature on preparation and development of beginning mathematics teacher educators. It also provides another perspective to the largely “self-study” approach to the process of learning to teach future teachers. It examines this process in the
context of a graduate course aimed at supporting the development of future teacher educators. In addition, this study serves to open up the conversation on (a) what is involved in learning to teach prospective teachers of mathematics and (b) the kinds of formal and programmatic experiences that might help prepare future teacher educators to learn to teach K-12 preservice mathematics teachers.

**Theoretical Perspectives**

The design of the course and study draw on the perspective of learning to teach as a complex life-long process (Feiman-Nemser, 1983). Similarly, processes of learning to teach prospective teachers are considered life-long endeavors that cannot be addressed solely through course work or teaching experience. This is also consistent with constructivist views of learning as prospective teacher educators come to graduate school with past experiences, knowledge, and beliefs, which influence how each will experience the teacher education program as learner and as teacher. The study also takes the perspective that teachers’ practices are shaped by their knowledge and beliefs (Borko & Putnam, 1996; Calderhead, 1996) and therefore these must be objects of inquiry and sites of learning. With these in mind, the course aimed to provide students with experiences in support of the following goals (each illustrated with an example of the kinds of activities that aimed to support them:)

- Examine perspectives on what teachers need to know and be able to do to teach mathematics in elementary and secondary schools. Supported by examinations of their own ideas through mathematics education biography and learning about others’ perspectives as stated in standards, course syllabi, readings;
- Experiment with a variety of pedagogical approaches and resources in mathematics teacher education. Supported by reviewing and trying resources and developing records of practice and/or a collection of teaching resources along with a statement of teaching philosophy;
- Become familiar with the variety of contexts for teaching and learning in the teacher preparation program. Supported by creating a map of program in relation to their teaching assignment; observing in other classes; interpreting these in light of National Council of Teachers of Mathematics (NCTM) research companion and/or other relevant readings;
- Consider questions, approaches, and methods of research in mathematics teacher education. Supported by reading and discussing research articles that used different approaches and methods to investigating similar research questions; and
- Design and conduct research in the context of their teaching. Supported by discussions of various iterations of drafts of ‘researchable questions’; public poster presentation of draft question and research plans; paper and presentation of research project findings.

**Data Sources and Analysis**

Data collected focused on class activities and participants in the “practicum in teaching” course. Instructors for the course are both junior faculty who teach in the teacher preparation program at this institution. The course meets throughout the Fall and Spring semesters and it is scheduled as a 2-hour seminar and a lab activity every other week. The data consist of class agendas, written assignments, audiotapes of selected class discussions, students’ feedback and interviews regarding their experiences, and classroom observations of the participants’ teaching.

Participants include first and second year doctoral students with varying degrees of K-12 teaching experience, with different nationalities, and with different teaching assistantships (secondary or elementary). Data of eight course participants collected over two years are used to construct individual cases that are later used to uncover patterns and develop themes across cases (Yin, 1989). Case studies document prior experiences, knowledge, and beliefs these novice teacher educators brought to the course, as well as how those factors interacted with their learning from course activities and from their own teaching experiences. We present preliminary insights and provide an overview of questions we are continuing to explore.

One theme that emerged through this analysis is that of identity, which led us to explore the role it plays in the ways in which participants engage with course activities. One identity-related theme is students’ reluctance to call themselves “teacher educators.” One participant, for instance, wrote “Sometimes when I really think about where I am and why, I am surprised. My most bizarre vision of what I might become when I finally grew up never included math teacher
Another stated: “While I have always wanted to be a teacher educator, I was as surprised as anyone to discover that what I wanted to focus on was math.” And another confessed: “I found myself interested in teaching teachers because I needed a job in graduate school.”

Another theme we examine is the value participants attributed to the “practical” and “research” aspects of the course, and the ways these activities influenced their thinking and teaching practices. Throughout the course, students had opportunities to analyze syllabi, create and discuss records of teacher educators’ practices (lesson plans, cases, class videos, observations of others’ teaching), and analyze preservice teachers’ work. They also had opportunities to engage in more research-oriented activities, such as reading and analyzing research papers with a focus on mathematics teacher education, designing and conducting a research project within their teaching context, and sharing their work with a broader audience through presentations. Understanding our participants’ perceptions of their experiences with these two kinds of activities can shed light on their development processes.

Results

We choose to report by theme rather than by individual case to ensure anonymity of our students. To that end, we are purposefully unspecific about the research project questions any one student investigated since these projects have been presented at conferences and might become publications. We use clusters of quotes and summarize similar points of views so that no one particular case is revealed. Instead we present the results as a composite case of the common issues experienced by the students. Next we report on preliminary findings from our analysis of the data. First, we report on students’ experiences related to developing a mathematics teacher educator identity; and second on interactions with the teaching and research related activities of the course.

To Be or Not to Be! Challenges of Becoming a Mathematics Teacher Educator

Wenger (1998) argues that learning involves the development of identity, the changing of who we are, in the context of the communities of practice in which we participate. He states: “Because learning transforms who we are and what we can do it is an experience of identity. It is not just an accumulation of skills and information, but a process of becoming—to become a certain person or, conversely, to avoid becoming a certain person” (p. 215). Our identities, then, are shaped by our participation or non-participation in various practices, which in turn shapes our communities of practice. Developing an identity is a constant process of negotiation. “We are always simultaneously dealing with specific situations, participating in the histories of certain practices, and involved in becoming certain persons” (Wenger, 1998, p. 155).

The move from classroom teacher to graduate school is as awkward as any other life event when the old self moves out of familiar places and practices and into new ones. The graduate students came with varying degrees of experience teaching in K-12 schools (zero to ten years); three had teaching experiences beyond K-12; one taught content courses (in a different subject); another taught teacher education courses outside of the U.S.; and another was a teacher leader who provided professional development to other teachers.

The students differed in teaching assignment (elementary, secondary, not teaching). The three who were not teaching ‘shadowed’ another instructor throughout the duration of the course. They also differed in the extent to which they identified themselves as ‘math smart’ or ‘math strugglers;’ and in their views on their accomplishments as teachers. Most, regardless of background in mathematics (major, minor, minimal), considered themselves ‘math frauds’—students who had good or hard-earned grades but had never really understood mathematics until some life changing experience with it occurred (during undergraduate studies, in teacher preparation, in professional development) that hooked them into wanting to learn more for themselves and share it with others. Some said they liked mathematics more when they started to teach than when they studied it in school. Regardless of their experiences with mathematics or teaching, each student had come to graduate school because they wanted to learn more about mathematics, research, and/or teaching.

As mentioned earlier, students hesitated to identify themselves as mathematics teacher educators. In their mathematics education biographies they wrote little about what they
anticipated learning and doing in their new teaching roles even though this was an explicit prompt of the assignment. We gleaned more into their ideas through discussions and later assignments such as when we asked the students on the first day of class to find their place in a continuous line labeled math/math educator at one end and teacher/teacher educator at the other end. We also asked students to quick-write and discuss responses to questions such as: “What do you think is the most challenging thing about learning how to teach mathematics? What do you think the most important thing is you can do to help your students learn to teach well?"

The map of the teacher/teacher educator—math/math educator revealed that our students located themselves nearer to one of either side rather than close to or at the middle. Students’ responses to questions that elicited their thinking revealed the wealth of knowledge and ideas they had brought with them that were consistent with many of the views and goals explicitly stated in teacher preparation standards and our institution’s program standards but that also lacked clear articulation. Their statements also revealed their troubles identifying the expertise they brought that could help their students learn to teach well. Their responses to what is challenging about learning to teach mathematics included: “move from being a student to becoming a professional,” “teaching people that are different from yourself,” “developing a good understanding of mathematics,” “managing class discussions,” “develop confidence in own ability to do math” (elementary majors), “translate content they know to make it understandable to kids” (secondary). Responses to what they could do to help their students learn to teach well included statements such as: “model good practice and being a transparent facilitator—letting them see what you’re thinking,” “being flexible, positive, and open-minded,” “help them understand the whys in mathematics.”

Students were less clear or forthcoming about the experiences and knowledge they brought to their new roles. Their statements reflected desires to share and promote in their future students a passion and enjoyment with mathematics and teaching: “My gift as a teacher educator is that I know what a mathematical awakening looks like;” “I want to provide preservice teachers with the kinds of mathematical experiences I had.” Their comments also reflected views of teachers and teacher educators in their past that they wanted to emulate and others they much rather not be. They described teachers who did or did not practice what they preached, who knew (or not) their content and could or could not teach it, and teachers who did and did not seem to care for their students.

These comments make evident students’ preoccupation with establishing themselves as knowledgeable teachers who care for their students. The students’ reluctance to claim identities that included expertise in the subject and or practices of mathematics teaching interacted in interesting ways with the course activities, teaching assignments, and their developing identities as mathematics teacher educators. Consider the double bind for them to claim an identity either as a math struggler or a math smart. Claiming either identity undermines the possibility of connecting with future teachers of mathematics who look to ‘learn from’ either an expert in the content they will be teaching or someone who understands what is like to struggle with mathematics. These identity ‘crises’ created two interrelated challenges that participants experienced throughout the course—developing credibility and integrity as mathematics teacher educators.

Issues with developing credibility (being regarded as having expertise in the content and practices of mathematics teaching) arose during the course activities when these revealed the participants’ inexperience with either mathematics and/or with teaching practice. These occurred, for example, when particular content was examined through a reading (e.g., division of fractions in the case of Ms. Daniels in Borko and colleagues, 1992), when students presented their ‘researchable questions’ to other mathematics education students and faculty across our campus in a public poster session, or when peers or instructors challenged their ideas about mathematics or teaching. In the context of their teaching, issues of credibility were more pressing when their knowledge and practices were challenged by their students, the collaborating teachers who worked with their students, or by fellow instructors. These issues were amplified by the history and reputation of the teacher preparation program in which they now worked and studied.
Issues with developing integrity in their practice (modeling the kind of mathematics teaching they wished to promote) were also constantly brought to the fore during course discussions and activities. Typical opening discussions during the seminar where students would share ‘how things were going’ in their classes were filled with stories of struggles to enact what they believed to be good teaching practices in a context that was not quite like the classrooms they had left behind. The fact that their students were adult learners who did not appreciate being treated as children (even if role playing), for example, was one such challenge to modeling the kinds of practices they wanted their students to experience and adopt. Another was facing the fact that they were now outsiders to what happens in real mathematics classrooms (they were no longer practicing teachers, had not taught in this country, or had not taught at all) so using examples of their own teaching did not always achieve the intended purpose. Another challenge was to allow their teacher education students to take risks and make mistakes—which they valued as a process for meaningful learning—when those mistakes involved real children. Resisting the temptation to give into a pedagogy of ‘showing and telling’ turned out to be much more challenging than any of them had expected. The following quote written by one of the graduate students during the second half of the course reflects issues of credibility and integrity the students experienced.

How do we create meaningful activities, engage in powerful and reflective dialogue, and facilitate conversations if our personal contexts and those we teach in are so different and all disconnected from the reality of specific classrooms and kids? Is there a “better” way to construct teacher education? If so, how might this look?

Researching and Teaching: Looking for Connections and Balance

The challenge of developing an identity as a mathematics teacher educator is also a challenge of learning to connect and balance the worlds of research and teaching and learning and to move from the outside to the inside of (and between) these communities of practice. The students’ positioning as insiders or outsiders to either practice interacted with the course requirement to conduct research in the context of their teaching. This brought to the fore tensions between research and teaching in ways that typical work in doctoral courses do not.

Tensions between researching and teaching are widely documented in educational research literature where disparate views about their relationship abound. Some say that educational research does not speak to the concerns and interests of teachers (Atkin, 1992). Others observe that educational research does not often seem to speak to academic researchers either (Eisner, 1984). There are those who see the two practices in competition with one another (Kline, 1977; Wong, 1994) and those who claim the two are essential to one another (Wilson, 1994).

Issues of connectedness and balance when conducting research in the context of their teaching became explicit foci of conversations and preoccupations for the graduate students and their instructors. Questions raised throughout the course in relation to these issues included: How much emphasis and attention should be placed on teaching and how much on research projects? Where do research questions come from: theory, practice, both? How are these kinds of questions different or similar? Does research inform teaching? If so, in what ways? How can one be both a believer and a skeptic of one’s teaching and what students are or are not learning?

Issues of connectedness between researching and teaching were experienced differently by those who were and were not teaching during the course. These were evident in the kinds of ‘researchable questions’ the two groups of students posed, how much or how little their questions changed over time, the extent to which their questions focused on exploring, assessing, or changing their students’ thinking, in terms of the conclusions they reached about what the students had or not learned in teacher education courses, and the value and usefulness they attributed to teaching and research related activities of the practicum in teaching doctoral course.

Issues of balance between teaching and researching were also experienced differently, although both groups (teaching/not teaching) spoke often of not letting their teaching and/or research activities ‘take over their lives.’ Questions of balance were brought up for both groups when they had to make a final commitment on what to study in this context when they admittedly had many questions and wanted to learn as much as possible about teaching future teachers. Questions were also raised by both groups about the expectation that they would devote
ten hours a week to their teaching responsibilities (as stated in their teaching assistantship
contract) and the fact that they were (or could see themselves) working twice that amount of
time.

Another issue of balance had to do with figuring out what could be learned from their
research studies that was specific to their teaching. Those who were teaching seemed to have a
harder time relating their research to a broader audience whereas the other seemed to struggle
with drawing lessons from their studies that would help them in their future teaching. Finally
another issue of balance related to how much time was spent in the course on either of these
activities and the challenges of designing meaningful discussions and activities around disparate
teaching contexts and research projects. The following quotes reflect issues of connection and
balance in the students’ writings. Both reflect insights they experienced through research
activities that connected with their teaching. The latter raises questions about the feasibility of
doing research while teaching.

Previous [to this research project] my true goal, even when asking questions, had
always been to change my students’ teaching—to get them to expand what they had
done well and reduce what had been done poorly. It was only when I gave up that
agenda that I was really able to hear what my students were saying and to give them
the space to reflect on their own teaching.

This is the first time I have ever transcribed anything. I often found that I would type
out what I heard and then listen to the tape again only to discover that I had
unintentionally edited the transcript. Usually my mental editing maintained the
meaning, but occasionally the meaning was different! I was amazed at how much
information I might lose by taking notes and not audiotaping. But who has time to do
all this?

Discussion

We return to the questions raised earlier to discuss the significance of these results. In terms
of what is involved in learning to teach future teachers of mathematics, we find evidence in our
data of Wenger’s proposal that processes of learning, in this case of learning to teach future
teachers of mathematics, involves not just an accumulation of skills and information, but also an
experience of identity—that of becoming or avoiding becoming a certain person. In this process
of becoming, students wrestled with common challenges associated with beginners—credibility
and integrity. This is an interesting parallel to challenges associated with beginning and novice
teachers. This suggests that these issues (and perhaps others) are indeed central to what it means
to learn a new practice such as the practice of teaching. Finding these factors present and central
among this new population (preservice teacher educators) serves to reinforce their generality and
thus importance.

Another important result relates to differences found between the two groups of students who
participated in the course—concurrent and delayed teaching. These students’ experiences in the
course differed in terms of their developing identity as mathematics teacher educators but most
prominently in their perspectives on what was interesting, useful, feasible, and valuable about the
teaching and research aspects of the course. Whether one had an authentic context in which to
explore what was being learned in the course played out in some unexpected ways. It issued
challenges in terms of how either group connected and balanced activities of teaching and
researching. Managing these challenges afforded and constrained what students chose to explore,
what they chose to experiment with, and what they could see from their research studies.

In terms of the kinds of formal and programmatic experiences that might help prepare future
mathematics teacher educators, we propose that it is possible for a course to offer rich learning
opportunities for those who are concurrently teaching and to those who are delaying teaching
(but have a teaching site in which to explore what they are learning in the course). Although it
can be challenging to design experiences that are meaningful to both sets of students, restricting
the course to either group would limit the richness of their respective experiences. We also
propose that such a course needs a dual and equal focus on teaching and research activities.
Attention to either one alone would fail to address the development of the students’ identities as
mathematics teacher educators as well as their ability to see and seek connections and balance between the two practices.

References