Chapter 3

Case Story: Mathematics Teaching Assistant

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Through narrative inquiry research, this report uses the format of a personal journal to tell the story of mathematics graduate student experiences around being a teaching assistant. Created through reflective writing and discussion by participants in a college mathematics proseminar, the journal is written in the collectively defined voice of one graduate student. Journal entries highlight topics of concern that range from managing instruction and graduate coursework to balancing home, teaching, and junior researcher roles, searching for jobs, and learning about potential responsibilities as future faculty members. To support graduate students and those who mentor them, the journal entries are followed by recommendations that summarize and extend current research and practice literature.

> *August 23, 2002. Friday: Week before the start of Semester 1.*
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> The day started with a two-hour orientation to being a graduate teaching assistant. There were dozens of people there and we were all from different departments. This afternoon was the math department's orientation. The teaching seminar leader spent about 40 minutes talking about how important our work was in the lives and experiences of the undergraduates in our classes. Then the department chair spoke for about five minutes about how we were in graduate school to become researchers in mathematics and to make sure we didn't spend too much of our time on teaching. After that, a few introductions to some other math TAs and faculty, then I went to the course coordination meeting. I was handed a textbook, a sample syllabus, given a pat on the shoulder, and told to go teach on Monday.

The excerpt presented above is the first of many entries in a synthesized journal we generated to tell the story of the first three years in graduate school from a mathematics teaching assistant's (MTA's) perspective. In this article, successive entries from the journal are provided for two purposes: (1) as a case exemplifying the current state of graduate mathematics education in a concrete and compelling way and (2) as points of departure for discussion by those involved in the research and development of graduate education in math-

ematics departments. The journal entries are an amalgam of the experiences of 12 people involved in a semester-long professional seminar, or *proseminar*, in the mathematics department at a doctorate-granting institution. Proseminar participants ranged from first-year graduate students to faculty members in their second and third years of tenure-track positions. The seminar leader was the first author, a PhD in mathematics who had completed a postdoctoral fellowship in research on collegiate mathematics education and was in the third year of a tenure-track position at the university.

To maintain the flow of the story told by the journal, we chose to present the entries as a whole. Below, we review our methods, provide the journal, and then close with a discussion of connections to the literature along with implications and recommendations for MTA professional development.

Method

The study used a kind of group narrative inquiry called case-story methodology, a form of qualitative research that relies on participants to tell stories, collectively determine their relative significance, and collectively revise the stories (Ackerman & Maslin-Ostrowski, 1995; Patton, 2003). This case story approach provides information on the nature of graduate MTAs' experiences across temporal, locational, and social contexts (Clandinin & Connelly, 2000; Denzin, 2001).

The development of the journal entries was ethnographic and organic, evolving through the reports of proseminar participants about their experiences in a weekly proseminar on the teaching and learning of college mathematics. Participants taught various service courses in mathematics, mostly calculus, precalculus, and prospective K-8 teacher courses. Each seminar meeting focused on one or two activities around teaching, learning, or evaluation. Activities ranged from participants reporting on their observations of peers' teaching to discussions of excerpts from the research literature (e.g., Herzig, 2002), college mathematics teaching "cases" (Friedberg, 2001), classroom management approaches (DeLong & Winter, 2002), and teaching evaluation forms (Center for Education, 2003).

The project began as the result of frequent "Oh, me too!" moments during the first two meetings of the seminar. By the third meeting (of 15 during the semester), if someone related a story and at least two other people agreed that the experience was familiar or resonated with their own experience, the seminar leader said, "Okay, stop! Write about that for five minutes." All participants quickly wrote out their thoughts related to the topic, set their papers aside, and the seminar continued with the planned activity for the day.

Over the remainder of the semester, the proseminar leader and participating faculty familiar with the literature on college mathematics teaching and

learning chose excerpts — based on the nature of the experiences shared by participants — from published work to be used in seminar activities. In this way, the proseminar participants not only generated a record of their own experiences, but also had a means for comparing that record with reports in the literature about graduate students and new college faculty. In fact, the proseminar participants extended their writing about their shared experiences beyond the brief writing completed during the seminar meeting. Usually within a few hours of a five-minute quick-write activity, participants sat down at a computer and fleshed out their brief versions to create anecdotes that included concrete details or expanded the reflection to include an examination of the ways their thinking had evolved over time. Participants emailed these expanded versions of their quick-writes to the proseminar leader who collated them and brought printouts to the next gathering. At the next 50 minute meeting, about 10 minutes were spent reviewing stories and determining which parts of the reported experiences were most common or most powerful. Then, the seminar activity for that day began. The next time several participants identified a common experience, the same five-minute quick-write occurred along with another follow-up expansion. This cycle of writing and expanding stories became the development of the journal presented here. The seminar leader took the expanded writing about the first three experiences and, with participants' permission, edited them to have a single voice — as if one person were reporting the experiences. Several in the seminar group expressed interest in continuing the journal-building process and all in the seminar continued to participate in quick-writes about shared experiences. The former group became the authors of this piece.

Through reading and revising the emerging journal, the proseminar group reflectively examined their collective experiences in becoming a college teacher. At the end of the semester, the group agreed that the resulting journal was a thorough and fairly complete overview. At that point, the authors identified issues illustrated by the journal and examined the literature on graduate student experiences, particularly research about mathematics graduate student experience. This work included reading, in full, the research, policy, and practice articles from which the readings used in the seminar had come.

Our readings of the existing literature related to graduate teaching assistant experiences covered the spectrum from empirical research to policy statements. In revising our 27-entry initial draft journal, we referred to theories of socialization into the professoriate (Nyquist & Wulff, 1996), policy statements on preparing future faculty based on survey and program evaluation data (Pruitt-Logan, Gaff, & Jentoft, 2002; Seymour, Melton, Wiese, & Pedersen-Gallegos, 2006), empirical reports on mathematics teaching assistant beliefs and practices in specific courses (e.g., in calculus, see Speer, Strickland, & Johnson, 2005), policy and development pieces about graduate school or teaching assis-

tants generally (see, e.g., Fowler, 1996; Prieto & Meyers, 2001) and in mathematics specifically (see, e.g., Herzig, 2002, 2004; Rishel, 2000), to determine which parts of the journal to keep, which to expand further, and how to frame each one.

The challenges encountered by the proseminar participants as MTAs included a limited experience in teaching upon entering graduate school, an awareness of the low status accorded to teaching in research-focused mathematics departments, difficulties around getting and interpreting feedback about one's teaching, how to work with undergraduates who bring many negative experiences in mathematics with them to college classes, and dealing with one's anxieties in facing each of the above. In addition, participants had in common an experience of isolation in starting a graduate program at a new place with unknown faculty, peers, and students in what was for some a quite foreign school culture; that is, MTAs had the challenge of learning how to "fit in" with the department in terms of the mathematical, social, and linguistic preparation they brought with them and in the ways they saw the academic world. The story told in the journal also includes the challenge of balancing the demands of a variety of roles at home and school — spouse, parent, graduate student, teacher, and researcher. Moreover, proseminar participants discussed themselves in relation to the mathematics research process: both generally about becoming a scholar and particularly about being a professor, including what a professor does and how to apply for and get a job. Many MTAs' learning experiences as undergraduate mathematics majors differed dramatically from those of the undergraduate students they taught.

In what follows, each excerpt from the journal is prefaced by a question or questions identifying the central issue or issues illustrated by the excerpt. These questions are aspects of the dilemmas mentioned above and are an indicator for the reader of the topic that generated the entry. For example, the first excerpt highlighted the central issue, "How does one get mentoring about teaching?" — a topic that arose several times in the proseminar — while the next excerpt was generated during a discussion of the meanings of "teaching" and "learning." Though proseminar participants reported several different formats for their MTA experiences, from discussion or recitation facilitator to instructor of record, the narrator in the journal has been situated as an instructor of record who is responsible for writing syllabi, quizzes, exams, and assigning semester grades.

Year 1 (continued)
August 26, 2002. Monday: Week 1 of Semester 1.
What is good teaching?

Well, my first day of teaching is over. That's about the best thing to be said about it. It's over. Only 14 more weeks to go. I have no idea what I'm doing. I only know I don't want to be as horrible as the TAs I had my freshman year. I think I wasn't. I hope I wasn't. I'm trying to be like my good teachers, but to tell the truth I wasn't really paying that much attention to *how* they were teaching when I was a student. The main thing that threw me today was how the only questions I got from students were about testing and grading, nothing about the math. Well, except for the girl who pleaded with me after class "Please, please, do not use fractions in this class." How on earth can I teach precalculus without using fractions?

October 21, 2002. Monday: Week 9 of Semester 1.
Who are all these people? How do I deal with disruptions? Where do I fit in? How do I manage being a student, a teacher, and handling my personal life and do it well?

My first semester of graduate school is tough. I don't feel that it is the classes that are so difficult. Instead, it is the act of trying to fit into a department that seems so radically different from the one I just left as an undergraduate. Trying to fit in with the other TAs seemed daunting at first. All of the TAs seem very different from me and many are older. I don't feel comfortable asking them questions about coursework because I feel like they are looking down on me (in reality they probably are not). The exception so far is Pat, who has been here two years already, is very smart, and doesn't make me feel stupid for asking questions. Our office desks are right next to each other, which has led us to discuss our classes, students, and the faculty. Pat is my life preserver right now.

Pat's the one who suggested I advise the "no fractions" student into pre-algebra. I don't know if she went to pre-algebra, but at least she's not coming to my class anymore. Now I'm dealing with this guy, Daniel, who won't shut up in class. Every time I talk at the board, he starts talking. Every time I stop, he stops. It sure doesn't feel like he's talking about math and after the D he got on the midterm, I sincerely doubt it. Like the please-don't-do-fractions girl, I advised Daniel to drop. He told me "it's not an option." I didn't know what to say. Still don't. Pat says I need to just let it go, saying, "The best way to deal with a student who wants to avoid math is to avoid that student. If you can't get them out of the class, just ignore them." Pat says paying attention to him is "just what Daniel wants," as if it's a bad thing. But why is it a bad thing to pay attention to Daniel? I just don't know and don't know how to find out. So, I dread going to that class and am relieved when his seat in the back row is empty. At least the students in my other class seem to be listening to me. Then again, the midterm average in both classes was about the same. So, even though my perception of the classes is that they are different, who knows what the students' experiences are in the two classes?

Not only am I struggling with how to teach, I'm also working on the balancing act of being a TA and a graduate student, not to mention my new role as spouse. To get the tuition waiver I have to teach an average of six credit hours per semester (two 4-hour classes right now and one in Spring) while also enrolling in at least nine credit hours of graduate work. Being a first-year TA, the amount of time it takes me to teach is turning out to be pretty much the equivalent of a full-time job. Okay, I am a little on the obsessive-compulsive side, but teaching eats up a large part of each day between the work I do for it like preparing lectures and grading and the time I spend thinking about how to do it.

October 25, 2002. Friday: Week 9 of Semester 1.
How do I know if I am ready for a graduate course?

I am enrolled in a graduate class taught by Professor K who has the reputation of being a very difficult teacher. And, to say the least, my undergraduate studies did not adequately prepare me for an intermediate graduate course. A dilemma has presented itself: Learn basic material at the same time as the more advanced stuff in the course or survive as a TA. I asked Professor K if there was any way to do the last homework assignment without using tensors. I really don't understand them. He said to get a book on tensor calculus or drop the class and take Calc III again. Ouch. I got a book and Pat is helping me with tensors.

November 30, 2002. Saturday: Week 14 of Semester 1.
How do I manage being a student, a teacher, and handling my personal life and do it well?

Thanksgiving is gone. Only a few weeks left in the semester. As the semester has progressed my work in Professor K's troublesome course has not. I am spending most of my time worrying about what and how I am teaching, not on my graduate class learning. My downward spiral started when I rationalized the decision to be under-prepared for the classes I was taking rather than for the ones I was teaching. I am withdrawing from Professor K's course. This way I will finish the semester alive and will pass my other two courses. My failure to complete that course is related to the fact that it is my first year teaching but there are other factors at work. With my undergraduate background being what it was, I was ill advised and should never have been allowed to enroll in Professor K's course in the first place. Also, because I feel the pressure of 62 students looking to me to be an excellent teacher and only one professor looking to me to be an excellent student, I spend my time on teaching. Although I am being paid less (as a TA) to teach than the full-time instructors are paid, my students have paid the full price for the tuition and I don't want to shortchange them. I was an undergraduate this time last year myself.

January 16, 2003. Thursday: Week 1 of Semester 2.
What are students thinking? How do I communicate with students?

I thought I would find that the fewer classes I taught, the more time I would have to commit to other things. This hasn't really turned out to be the case. I find myself using the time that I would have spent on a second class to improve in the one class I have to teach. Especially since I found out my students all have calculators this semester. One of the postdocs was supposed to teach the class but she's teaching differential equations instead. Apparently she arranged for the catalog to say students enrolled in the section had to have graphing calculators. Now I am spending time trying to create some good examples that make use of the graphing calculator. Anna told me about a calculator examples book that goes with the text, and I am going to look for it as soon as I get a chance. Well, at least I know more about the class and what to expect from the students taking it for "general" education. I still don't know what to say when they ask, "When am I ever going to use this?" except to say "I don't know and so why not learn it." I talked to A.J. and Pat about this but they said they didn't know either. Maybe I'll bring it up in the teaching seminar that starts this week. I didn't take it last semester because I had too much to do. I found out I had to take it in my first year or I wouldn't get rehired next year. Okay, so I'll go, better late than never I guess. I certainly want to know how to deal with things like the guy who freaked out in my pre-calc class last semester when he got a D on the first test.

March 8, 2003. Saturday: Week 8 of Semester 2.
How do I become a better teacher? How do I know if my teaching is better?

When I came to graduate school I had two main goals for my teaching: center class on ideas that were interesting and minimize cheating. I worked on exams to make sure I gave students ample time. It was not until this semester, as I am taking a graduate seminar in college teaching, that I have begun to evaluate my "assessment goals." Being forced to have my exams reviewed by a seasoned professional has brought to light many of the assumptions I had about teaching and how learning should be evaluated. Questions like "What proficiency are you testing for by including this problem on the exam?" or "Have you asked for this information more than once? Why?" and "How will a student who only knows the basics of what you taught do on this exam?" are all now a part of my planning. I find myself questioning my motives on a regular basis and feel this reflection has a tremendous impact that improves the quality of my teaching. I will find out whether or not this is true if I actually go through with the "mid-semester" evaluations suggested in the seminar. To be honest, I am afraid to ask the students what they think. It feels to me like things are going well. But, I might be wrong.

March 12, 2003. Wednesday: Week 9 of Semester 2.
What do my students need? How do I respond to those needs? Which needs do I respond to?

Okay, I did it. Mid-semester evaluations. Whew! There were only four questions, or as the seminar leader Professor D would say, "prompts":

1. Describe two things that you have learned in this class.
2. Describe two things we have covered in class that you wish you understood better.
3. What challenges are you facing regarding this class right now?
4. What do you need (from yourself, me, classmates, etc.) in order to meet these challenges?

The nice part was that they (the students) said they had learned some things. This is good to know! Although, I have to admit, the things they said they learned are much more basic than I would have guessed. Several of the things they described that they wished they understood better are things I myself have struggled with. Hmm. Coincidence? I think not. Okay, I'll face up to it and figure out how to get at those ideas better. I suppose that's one good thing about still having six more weeks of class, I can still do something about those ideas being understood. I was surprised by the kinds of things they said were challenges. Several people said they were working so many hours a week they didn't spend the time on homework that they should. Okay, that irritated me. Why are they in school if they aren't going to spend the time on school? How do I address that? I will not lower my standards. I'll ask in seminar and ask Pat about it, and maybe A.J. too. The suggestions the students gave were kind of weak, like "I should spend more time on the class." Yeah, they should. But will they? Maybe I'll bring it up in seminar.

Something very deep came up for me when I was discussing my students' comments with Zia, who is also teaching pre-calc this semester. She and A.J. were talking about mathematics being a foreign language for some students. A.J. mentioned that students seemed very afraid of algebra, very anxious about mathematics and that some students had said in office hours, "We'll just have to fake it 'til we make it." Zia said her students seemed to be treating mathematics the same way she had learned to treat English when she first came to grad school. It didn't seem to her that English always made sense, so at some point she gave up on trying to make sense of it. Instead, she began listening for and using common phrases, even though she didn't always use the phrases correctly. She learned their use through trial and error. Suddenly a light shone on a lot of the interactions I've had with my students. It never occurred to me that anxiety about math and their infuriating tendency to "fake it" were connected. Yes, I had noticed many students had some powerfully negative feelings about math, but I'm not a psychologist and didn't feel it was up to me to help them deal with that. I had also seen that many seemed to not know what they were talking about and said nonsensical things on tests and quizzes. But I didn't connect it up. This idea that mathematics is a language had occurred to me before. What hadn't was the idea that my pre-calc students would think of math as a foreign language that they could not ever make sense of and that, as a

result, they might be throwing around common math phrases without being sure of what they meant, trying to eventually understand "zero product rule," "the quadratic formula" or "roots of the equation" by trial and error on the contexts in which they got the phrases right. This leads to another question for the seminar: Why do so many pre-calc students seem to think that math does not or cannot make sense? I mean, when I needed to figure out tensors for Professor K's class, I got a book and figured it out.

March 14, 2003. Friday: Week 9 of Semester 2.
What do I do to deal with feeling overwhelmed and alone?

I was reading back over my journal and noticed I hadn't mentioned anything about my graduate courses this term. That's probably because I'm spending so much time on them with the study groups I have gotten involved with. I know how to study, well, mostly. It is the preparing to teach that is still new enough that I get a kind of avalanche-hanging-over-me-waiting-for-a-loud-noise-to-come-smothering-down-on-me feeling. I talked with Pat, Lee, and A. J. after studying last night and mentioned my pending avalanche feeling. Ironically, that led to skiing and now we are planning a trip for Spring break.

We also talked about the problems we were having in the classes we were teaching. Some of the time was just listening to each other vent frustrations. I have been to two dinner parties now this semester where the only rule was that we couldn't discuss school (learning or teaching). These things (dinner, skiing, and the musical on-campus we went to last month) are bringing us closer together as a group trying to deal with the stress of graduate school. Studying my fellow sufferers and the ways they talk about dealing with their problems as teachers and students is helping me to understand myself and to appreciate the value of working together rather than in isolation. I also found out that at least one of the more senior TAs is regularly going to the counseling center for help. When he mentioned it, I have to admit that at first I took a mental step back from him. But the more I think about it, the more I wonder if that's what talking with other TAs about teaching is giving me.

Year 2
December 19, 2003. Friday: Week 16 of Semester 3.
What is valuable, and valued, about my learning to teach? What priorities do I want for my teaching?

Finished another Fall semester! Finals graded, grades turned in, and I have looked at my evaluations. I had a new class to teach this fall, business calculus, two sections. It went much better than last fall, that's for sure. This time I used more of the ideas from Professor D's seminar; I especially like the mid-semester evaluations. My end of semester evaluations are better. Last fall my average was 3 out of 5 (5 being best). Now they are almost 4 out of 5 plus the comments students write are informative. The few days I didn't lecture and we did "interactive" sorts of things stand out as good for them. I'm not so good at activities where I am not leading but I think I would like to get better at them. I think one main reason I'm getting better has been the hour each week I have

been doing tutoring in the math lab. When I found out TAs had to do that for one of our office hours this Fall, I was not happy. And, to be honest, it hasn't been the most comfortable hour I've spent each week. But, boy, have I learned a lot about how students see their teachers, how frustrated they are with not learning, and how to figure out what a student knows and can do. I remember how surprised I was when one of Pat's students, Joey, came in about mid-semester and asked whether the slope of a line was related to a derivative. I asked what the teacher had said and Joey showed me several pages of notes from Pat's class, but said he couldn't make head or tail of them because Pat went so fast. I worked with Joey for an hour and a half that first day, and a half-hour every Wednesday after. I realized Joey could learn. He could understand calculus, but he wasn't getting much from Pat's lectures. This is part of what made me reconsider my own lecture-based teaching style.

I have signed up for another teaching seminar. Pat, who is graduating this year, asked me why I did that, since it wasn't going to count for anything. I wasn't sure what to say. I mean, I want to get better as a teacher, I want it to take less of my brain power and time to do it, so shouldn't I learn more about it? I know more now and am not feeling nearly as overwhelmed . . . more just "whelmed" I guess . . . as I felt at this time last year.

Din, who is new this year, was watching this conversation closely. Din was a grader this Fall and has passed the language exam to be given his own class in the Spring. I thought it was important for him to hear that the seminar was useful, so I actually ended up arguing some with Pat about it. I guess Pat doesn't know best about everything. I mean, up until today, I took what Pat said as gospel for the last year and half. In the end, I just said that maybe Pat had some natural talent for teaching that I didn't so I wanted the seminar as support and I turned to Din to ask if he was going to take the seminar with me. He looked back and forth between Pat and me and said he wasn't sure. I guess I felt, I don't know, like I had a responsibility to the new guy. So I started talking and kind of surprised myself with all the things I had to say about the seminar. It isn't really that there were so many ideas there that I could just take to class and use. It was more about having the regular, one hour a week time with other TAs. Yeah, we do social things and we have study groups but sometimes it feels like the older graduate students (more advanced I mean) would rather not talk about teaching, like they know how it's done and don't need or want to hear about it anymore because they're too busy. I can understand this point of view. I know I feel like there are twelve hours of things that I want to fit into every waking hour.

March 4, 2004. Thursday: Week 8 of Semester 4.
What is a scholar? How do I become one?

When I applied to graduate school I sort of imagined myself in a book-lined library at a big wooden table reading and working. I can't even remember the last time I went to the library. I know that sometimes if I can't find something on the Internet or electronically in the library from my desktop computer, I'll give up on it. Not very scholarly. I wish there was a seminar on being a scholar!

I like the ones I've had on teaching but there isn't much guidance out there on how to grow up and put it all together and be a professor. I know I'm supposed to find an advisor. I don't know how to do that. It will just have to wait until after my comprehensive qualifying exams. After all, I want to make sure that I pass before I start believing that I'll actually be able to start researching anything.

Year 3
November 15, 2004. Thursday: Week 12 of Semester 5.
What is valuable for my development as a teacher?

Defended my proposal today. Looks like I'll be writing a dissertation under Professor K after all. The research assistant job for next year fell through (Professor K didn't get his grant renewed, whatever that means). All I know is that he said it means I will be teaching next year. Should I ask to teach a class I've taught before? Will that take less time? Knowing me, I don't think so. I might as well teach something new.

February 3, 2005. Thursday: Week 4 of Semester 6.
How do I communicate with students? What is valuable for my development as a teacher?

Din and Zia were telling me about problems communicating with students. Din said he assumed that English was the national language and that everybody would speak Standard English. Then he said it took a while to figure out what a student meant when he said "I'm not buying that." He asked the student, in class, about it. Din went on for a while about everything in the U.S. being a business of some kind. Why, he asked, couldn't the student have said, "I don't understand that?" Zia and Din both said they wanted to use words and phrases students were comfortable with, so they had to learn them. We were sitting in the Zoo Room, the big room where about half the grad students have cubicles, and A.J. heard the conversation. A.J. said it was also important for the undergraduates to learn the "proper" academic language, especially if they were ever going to move up in the world. Then Lee chimed in and said that what was comfortable to some students might not be comfortable for all, and agreed with A.J. that using "proper" language was important, even if it wasn't comfortable.

Din asked if he could come watch Lee teach. Lee said okay. Wow. Having someone else watch me teach, I mean other than my students, would be hard. I know Professor D suggested it last Spring in the teaching seminar but, well, I made sure it never happened. I don't need that kind of aggravation.

February 28, 2005. Monday: Week 7 of Semester 6.
How do I get something out of a teaching observation? How does being a faculty member work? What kind of job will I be able to find?

I just read my entries for the last month and had to laugh. Din started this big trend when he asked to visit Lee's class to observe. I have had at least one other TA watching me teach every day for the last week. I have been surprised

at my own response to the strangers in my classroom (okay, I know them, but they feel like strangers). It's like worlds colliding or something. These are the people I studied with for comps, who were in classes I was taking. I still don't know how I feel about this observation business. I wish there was a way for me to get something out of it. I mean, the three TAs who have come to watch my classes have said "Thanks, you did great," but that's about it. Well, I'm still struggling with the whole research-teaching thing. Right now it seems as if I'll only ever be mediocre at each. What a difference from what I expected from graduate school. I have heard other people talk about "surviving" grad school and not understood. Now I am beginning to get it. I was talking to Professor W earlier this week. He was hired this last fall. It's his first tenure-track job. I asked what "tenure-track" really means. I mean I know it means you get to keep your job once you get tenure, but it was all kind of hazy to me. He said he had to do research, teaching, and service. Well, I pretty much know what the first two are, but "service"? He talked about committees, but lost me after a few seconds. I guess I'll find out when or if I ever get where he is. I still don't have any idea how to find a job.

April 8, 2005. Friday: Week 13 of Semester 6.
What is student engagement? How do I deal with it when I get it? How do I know if and when I am doing well? How do I learn of and apply for jobs?

As promised, Professor D showed up in my class this last Monday. She actually gave me good feedback. She commented on my questioning technique. She said that I was asking obvious, easy questions and that if I asked more complex questions and allowed more time for students to answer, I would probably get more and better student responses. So, I tried it Wednesday and today. I asked questions that weren't just fill-in-the-blank things. And I waited. Boy did I wait. Okay, so when I looked at my watch during the third "wait time" it turned out to be less than 15 seconds. I don't think I ever realized how long 15 seconds could be. By the end of the hour on Wednesday the students were obviously more engaged in what was going on. What amazes me is what happened today. I asked a question about the relationship between a new thing and something from Wednesday. And then I prepared for my wait by turning slightly away from the class for a second. When I turned back around seven people had their hands up. Seven! I wanted to hear each person but couldn't because I had so much to cover.

Now I am on the horns of a new dilemma: The students are getting involved but it takes up so much time! How can we possibly cover everything? I went to Professor D with my question and she asked me if I thought students could learn something even if they hadn't heard it come out of my mouth first. Hmm. I hadn't thought about it that way before. Well, yes, of course. I learned plenty as an undergraduate that didn't come out of my teachers' mouths. In fact, now that I think about it, that was part of how my best teachers taught. The good teachers had expectations of me that I could not fill just by parroting back what I had heard. Everything seems to happen in baby steps, then occasionally there's a leap. Like this afternoon when I met with Professor K to show him the

tiny result I thought I had. He congratulated me on finishing my dissertation and said all that was left to do was write it up. He also asked what kind of jobs I would apply for. Jobs? Then the memory of Pat's distress while putting together 150 job applications flashed through my mind. Apparently, as I work on writing my dissertation next year, and keep up my teaching, I am supposed to apply for jobs. Or, Professor K says I can look for a postdoc. It mostly happens — I'm not sure what all is included in the "it" — in November. He also suggested I do the Employment Register at the Joint Meetings. Well, I learned what the Joint Meetings were a few months ago when I went to the conference, but I wish I had known about the Employment Register. Also, I remember Professor W mentioning a "teaching statement" as being part of applying for jobs. He also encouraged me to keep taking the teaching seminar. He said to make sure I take it for credit, so it shows up on my university transcript, and that hiring committees would see that as something good. Now I have an idea for even another seminar: one on finding a job!

Discussion

The journal entries illustrate the phases of socialization reported by Nyquist and Wulff (1996) from senior learner in Year 1 through colleague in training in Year 2 to beginning to move into junior colleague in Year 3. In particular, in the social and locational context of teaching service courses in a university *mathematics* department, proseminar participants' stories indicate that the three phases overlap considerably. For example, a characteristic of the most advanced phase of "junior colleague" is an interest in outcomes of instruction, how and if students are learning, yet most of the teaching assistants in the seminar had stories and significant concerns about this topic, in their first year of teaching. Also worth noting here, is that though later entries were omitted from the journal provided in this report, some senior teaching assistants and new faculty members participating in the proseminar identified closely with the idea of "senior learner" as a descriptor of their teaching. However, these participants also commented that they felt they had moved through the phases of senior learner, colleague in training, and junior colleague and had come around again, cyclically, to the idea of co-learner with their students – particularly as they began teaching advanced undergraduate courses. That is, for the MTA experiences in this work, it appears that one, two, or all three may co-exist, and be available for development, in a first-year student. This seems to indicate a need for research that looks at the development and potential for co-evolution of these phases of socialization, perhaps as it varies in the context of different academic department cultures.

Connecting the Journal to the Literature

In addition to the broad issue of socialization, the temporal, locational, and social dimensions of experiences reported by proseminar participants resonate

with, and in some cases extend, suggestions offered by a variety of reports on doctoral students. Next, we describe seven key aspects in the literature on graduate student teaching assistant experience. For each, we connect the topic to related journal entries and note areas where the journal may offer insight into further work.

(1) *Provide graduate students with faculty mentoring, advising, and feedback on both their development as teachers and on how to balance their learning and teaching roles* (Fowler, 1996; Seymour, Melton, Wiese, & Pedersen-Gallegos, 2006; Speer & Hald, 2008). Nearly every journal entry referred to the need for more information on becoming a good mathematics teacher. The issue of balancing different roles arose frequently. For example, the journal entry for November 30, 2002 provided some evidence of this: "I am spending most of my time worrying about what and how I am teaching, not my graduate class learning." Though graduate students have a great deal of practice in learning mathematics through courses, most need faculty support for becoming critically reflective of their own teaching *and* for developing as a researcher. As was seen in the journal, one mechanism for providing support for good teaching is to establish a seminar or similar regular meeting focused on instruction. Recall the journal entry for March 8, 2003: "It was not until this semester, as I am taking a graduate seminar in college teaching, that I have begun to evaluate my assessment goals." With some expertise in college teaching practices on the part of the seminar leader, such meetings can supply information and provide a space for graduate students to explore questions about the nature, growth, and evaluation of good teaching and learning.

(2) *Provide teaching assistants with structured opportunities to talk with graduate student peers about teaching and graduate school expectations* (Copobianco, Diefes-Dux, & Oware, 2006; Herzig, 2004). For example, in the entry for March 14, 2003 our journal writer remarked, "I was reading back over my journal and noticed I hadn't mentioned anything about my graduate courses this term. That's probably because I'm spending so much time on them with the study groups I have gotten involved in" and that "Studying my fellow sufferers and the ways they talk about dealing with their problems as teachers and students is helping me to understand myself and to appreciate the value of working together." Opportunities to develop informal professional relationships, alongside the more formal relationships that emerge in a seminar, help MTAs maintain a focus on their studies while facing various teaching demands and help them fit in to a new department. The social dimension developed in such interactions may be especially important to the health, happiness, and productivity of graduate students whose home cultures are more collectivist than the mostly individualistic majority U.S. culture.

(3) *Give graduate students the opportunity to take on teaching responsibilities gradually over time* (e.g., grade for a term and observe others,

assist or team-teach in the second term, become instructor in the third term; Austin, 2002; Nyquist &Wulff, 1996). As illustrated by the first journal entry, teaching assistants are often "handed a textbook, a sample syllabus, given a pat on the shoulder, and told to go teach on Monday." The realities of the graduate school experience in mathematics in the U.S. means increasing teaching responsibilities over time may be difficult to implement. An area for further research and development is how to create a proxy for this form of support, such as team-teaching or having new TAs work both as teachers and as mathematics tutors. Participants in the proseminar indicated that the mathematics tutoring they did in addition to teaching helped them immediately in developing awareness of student outcomes to teaching, as was seen in the entry for December 19, 2003. In fact, the topic of what novice college mathematics teachers learn from working one-on-one with *other teachers' students* is, as far as we know, an unexplored area of research.

(4) *Offer information and guidance about the roles and responsibilities of faculty members in teaching, research, and service* (Carnegie Foundation for the Advancement of Teaching, 1991; Copobianco et al., 2006; Golde & Walker, 2006). Many of the later journal entries illustrate teaching assistants' concerns with becoming a scholar and a faculty member. For example, in the entry for March 4, 2004, we saw, "I wish there was a seminar on becoming a scholar!" and the February 28, 2005 entry commented, "He [Professor W] said he had to do research, teaching, and service. Well, I pretty much know what the first two are, but service?" Information about the roles and responsibilities of faculty members needs to include information about proposal and grant writing, advising undergraduates, outreach, and technology in teaching among other responsibilities. Such support has two effects. First, it builds awareness of what a faculty job entails, including what a scholar is and what the constraints and opportunities for scholarly work are like in various academic jobs (depending, of course, on the mission and status of the department). This can inform a student's decisions about how to prepare, while still in graduate school, for the kind of job wanted. Our journal narrator did this to some extent by continuing to be involved in the teaching seminar (see entry for April 8, 2005). In mathematics in particular, each year more than three-quarters of new doctorates end up with college positions that require them to rapidly build expertise in mathematics teaching and learning (Bruff, 2007; Kirkman, Maxwell, & Rose, 2006, 2007; Reys 2006).

(5) *Establish recurring organized reflection by teaching assistants on the demands of academe and the culture of the discipline* (Herzig, 2002; 2004; Golde & Walker, 2006). The socialization into a department, and eventually into the academy, is challenging, particularly for those whose undergraduate and home backgrounds are culturally distinct from the prevailing culture of academics. Proseminar participants remarked on two ways they dealt with the

difficulty of adjusting to a new environment: through questioning their previous preparation and questioning whether they were capable of graduate work at all. For example, the October 25, 2002 entry expressed the concerns that "my undergraduate studies did not adequately prepare me" for graduate work and later expressed doubt about passing doctoral exams. In both cases, the surrounding environment of the department was accepted as the norm to which to assimilate. Creating spaces for interaction by having seminars and informal gatherings are activities that departments can provide to lessen the isolation of graduate students and support their move into the new community of the department (Tinto, 1993). Moreover, depending on the structure and scope of seminars, such get-togethers can offer the opportunity for graduate students to apprentice to the professoriate as junior colleagues; giving them the chance to see themselves as future innovators and agents of change rather than only as assimilators into an existing culture (Golde & Walker, 2006; Seymour, et al., 2006). As noted, many teaching assistants want to get to know their fellow graduate students, to visit with them socially, and to work with them on their common classes and teaching assignments. Mathematics graduate students also seek opportunities to learn more about the academic culture from faculty members and, in part, may desire interactions with faculty for this reason. As noted in the journal entries and in the research, some students, particularly those from groups underrepresented on university mathematics faculties, have questions about what is valuable and valued as well as about priority-setting for their work as students and as teachers (Stage & Maple, 1996; Herzig, 2004).

(6) *Provide teaching assistants with opportunities for unstructured social interaction with fellow graduate students*. For many in the proseminar, at least as challenging as graduate classes was the work of "trying to fit in with the other TAs" (Entry for October 20, 2002). As illustrated in the journal, *unstructured* social interaction with fellow graduate students may help: "I have been to two dinner parties now this semester where the only rule was that we couldn't discuss school. These things are bringing us closer together as a group" (March 14, 2003). This sort of socializing was also seen as a critical part of answering questions about how to situate oneself in the graduate school environment (see 5, above). Also, proseminar graduate students have commented that a large room with up to five desks has been conducive to informal interactions (e.g., the journal entry for February 3, 2005).

(7) *Provide graduate students with information about different types of jobs, how to apply for jobs, and how to get a job*. Many graduate students are unfamiliar with the different types of jobs available and of some of the common mechanisms for preparing for and applying for such jobs. As in the journal entry for April 8, 2005, "Apparently, as I work on writing my dissertation next year, and keep up my teaching, I am supposed to apply for jobs. …Well, I learned what the Joint Meetings were a few months ago, but I wish I

had known about the Employment Register. I would have checked it out." Graduate students need guidance on getting and keeping a job. This ranges from identifying what kinds of institutions and jobs are out there and what the interview process is like, to the perspectives of those who are on hiring and tenure-review committees.

Recommendations

Given these seven points of theoretical consideration, we worked to develop a small set of very specific practical recommendations based on our own experiences — both those reflected in the journal and those around the proseminar idea itself. We offer suggestions here for ways to orchestrate the time and space for building formal and informal relationships and share some attempts we have made at our institution to implement what research and policy have suggested. The methods for supporting graduate student professional development given below are loosely ordered according to the amount of time and planning necessary. Please note that these recommendations are not exhaustive and assume perturbations to a traditional research-intensive mathematics department. Large shifts, such as teaching certification programs or educational development courses have been treated extensively by others elsewhere (e.g., Center for Education, 2003; Lewis, 1993; Ouellet, 2005; Seymour et al., 2006).

Recommendation 1. Hold a one-hour "graduate advising" session one evening each term, just before graduate students sign up for courses for the next term. At our institution, we gather commitments from graduate students and faculty to have a ratio of no more than three to one at the meeting. We meet in a room with small tables (three to six people each). Pizza and soft drinks are provided by the department, as are copies of the coming term's class schedule and university catalog. The meeting starts with 15 minutes of overview on courses to be offered. During this time, any faculty member can have two minutes to very briefly share information about a course. The remaining 45 minutes are spent at the tables, eating pizza and talking about course-taking and program decisions. In general, the graduate students who attend this advising session are pre-qualifying/pre-comprehensive exam students in their first two years of the PhD program.

Recommendation 2. Contact the institution's center for instructional development to provide staffing and topics for a regular (monthly or weekly) presentation or workshop on teaching and learning. Ask that the meeting occur in a room in the department's building/area (for example, in a place already frequented by the department's graduate students and faculty). Ask the center to be responsible for promoting the workshop. We note, however, that unless there is a specific focus on mathematics, at the least through the involvement of a mathematics faculty member as consultant, this approach may not offer

sufficient support for students immersed in the culture of a mathematics department.

Recommendation 3. Convene a one-hour per week departmental seminar on teaching and learning and require it for all first- and second-year graduate students in the department. Probably best led by someone with expertise in collegiate mathematics education, this seminar — not a lecture or presentation — is on specific topics, involves short readings, videos, or other prompts, and allows time for discussion (using, for example, De Long & Winter, 2002, or Friedberg et al., 2001). This recommendation includes the possibility of formalizing or extending "course coordination" efforts into one- or two-hour per week seminars that include explorations about teaching as well as "how to" discussions about specific course content.

Recommendation 4. Offer several one-hour colloquia each term, aimed at new faculty and advanced graduate students, to help both groups learn about the responsibilities of junior faculty members with respect to teaching, research and service. Format the colloquia to allow for the exchange of information among graduate students and faculty members (junior and senior) about finding and getting job information (e.g., what types of jobs are available, how to apply for jobs, and what qualifications are desired in a candidate). In our department, the proseminar serves this purpose. We set aside three meetings per year where we invite new faculty and recent graduates to talk about their job searches and ask senior faculty from our own and neighboring institutions (including a community college) to talk about the hiring process from the hiring committee side of things. Inevitably, the discussion extends to "requirements" for tenure. The diversity of experiences among the folks in the room makes it clear that the answer is always: "It depends on the school."

Recommendation 5. Enhance existing communication among graduate students and new faculty by creating in BlackBoard, or a similar web-based course management system, a virtual seminar that meets weekly. From our experiences with such a virtual seminar (in the term after the journal presented here was developed), especially when conducted in conjunction with course coordination topics, it takes the seminar facilitator about the same amount of time to lead as a face-to-face seminar. If a virtual seminar is pursued, use a computer program or administrative assistant to send email reminders to department members about the virtual meeting each week and include in the email a direct link to the seminar web login page. If there is a common password and login for all, provide that in the email as well.

Recommendation 6. Extend existing "course coordination" to include substantial seminar-like activities (see above) and peer observations of teaching. Observations of teaching will be most beneficial to those involved when using a common observation instrument accompanied by time for discussing the processes and reactions to observation. Possible instruments include those

found in the Center for Education (2003) online book, or our own form. For us, course coordination includes peer- and coordinator-observation of teaching and we all use the same simple observation form and three-step process (See Appendix).

Recommendation 7. Provide structure and funding for summer mentoring. The journal touches on the importance of mentoring students as they identify faculty roles and begin to see how they might take them on for themselves. The summer provides a unique opportunity for close work and time for mentoring and discussion between faculty and graduate students. Though not widely available, our institution has a fund for supporting graduate students over the summer with a stipend to work on faculty summer projects, as long as the students are "making timely progress towards their degree." These faculty projects include those centered on advanced mathematics as well as some focused on developing expertise in the pedagogy of college mathematics instruction and curriculum development. Each spring, a faculty member from the department's doctoral committee contacts faculty interested in mentoring a graduate assistant in the summer and gathers from each a brief description of summer research plans. These 50 to 150 word long faculty project descriptions include topic, time period in the summer of the activity, an estimate of the commitment expected from the graduate student (usually expressed in hours of work), and some detail about what the graduate student would be doing. Graduate students then apply for the opportunity to work with a faculty member whose project interests them.

Conclusion

Admittedly, graduate faculty at doctorate-granting institutions are rarely compensated (either with credit toward workload or pay) for efforts to advise, mentor, or otherwise help prepare teaching assistants for graduate school and beyond (Prieto & Meyers, 2001). Nonetheless, it is both our right and responsibility as the graduate faculty to prepare our students for the futures they choose.

Graduate students' future jobs may be quite unlike our positions. As Adams (2002) noted, people with doctorates are produced at fairly large research institutions but the vast majority of the graduates of these programs get jobs at two- and four-year "teaching colleges." Few graduate faculty members at research institutions have much knowledge of what such teaching-intensive jobs are like, largely because their own professional advancement is so closely tied to research production and so little tied to teaching effectiveness (Carnegie Foundation, 1991; Golde & Walker, 2006). Seeking a position where excellence in teaching is at least as significant a component as discipline-centered research requires a different approach from looking for a research-intensive job. A different sort of curriculum vitae is needed. In particular, professional teaching

portfolios are rapidly gaining power as evidence of a scholarly approach to reflective classroom practice and as components in college faculty evaluation (Border, 2002; Center for Education, 2003; Linse, Turns, Yellin, & VanDeGrift, 2004; Seldin, 1997). A next step in moving from the *Recommendations* offered above could be broadening those activities to include teaching portfolio development. Such development will help graduate students prepare themselves to be the kind of teacher-scholars sought by many postsecondary hiring committees (Adams, 2002; Boyer, 1990; Bruff, 2007; Fulton, 2003; Ouellet, 2005).

As graduate faculty at research institutions, we must prepare our students for the fact that fewer than 10% of them are likely to get jobs like ours (Adams, 2002; Metz, 2001). Most will have jobs with three, four, or more courses to teach each term. Many of the graduate students we work with are at least as interested in teaching and the scholarly development of their teaching as they are in discipline-specific research. One way to start supporting this diversity of graduate student intention might be to read and discuss the case story of the journal entries presented here. Other resources for postsecondary teaching development have been cited above and are listed among the references, including the case studies in college mathematics teaching created by Friedberg and colleagues (2001).

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Appendix

The Teaching Observation Summary form (see below) is used in a three-step process:

1. The instructor and observer meet in person or by email to discuss and record at least two things the instructor would like the observer to focus on during the observation.

2. The classroom visit. Observer takes notes on separate paper then writes draft comments.

3. The observer and instructor meet *in person* to discuss the observed class and to talk about what will be written on the Teaching Observation Summary form. When both agree to the content on the form as being a valid reflection of the observer's views supported by specific information from the observation, then both sign the document. For us, in the case of a peer observation, one copy goes to the instructor and one to the course coordinator. When a coordinator is the observer, one copy goes to the instructor and one copy is put in the instructor's departmental file.

Teaching Observation Summary

Name of Evaluator: _____Date & Time of Observation: _____

Name of Instructor: _____Course & Room Visited: _____

List two or three goals of the visit you and the observed instructor mutually agreed upon during your pre-classroom-visit meeting:

In responding to each of the following questions, please consider: organization, ability to motivate, comfortable learning atmosphere, demanding yet fair, enthusiasm, mathematical competency, appropriateness of material, group learning, assessment, etc.

1.Comment on strengths of the instructor's teaching:

2.Comment on suggestions for improvement:

Signature of Evaluator: _____Date: _____

Signature of Instructor: _____Date: _____