9

Preservice Mathematics Teachers Learning to Inquire Into Their Practice: Cases of Trying On Reform

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This chapter examines secondary mathematics preservice teachers' (PSTs) written cases of their classroom practice. This assignment was a means of developing PSTs' skills and capacity to inquire into their practice. Writing a case as part of a methods class, the PSTs had the opportunity to: (i) examine the complexity of enacting reform based practices that call into question beliefs about their teaching and learning; (ii) inquire and reflect on their practice by framing and reframing practice (Schön, 1983); (iii) learn from practice in ways that generalized to subsequent practice (Loughran, 2002); and (iv) create a knowledge of practice curriculum of novice practice for future PSTs (Cochran-Smith & Lytle, 2001).

Supporting new teachers to learn the understandings, skills, and sensibilities foundational to mathematics education reform and the teaching profession *begins* in university professional education. What is involved in this professional education is strongly debated (Cochran-Smith & Ziechner, 2005), but one thing that is common to many recommendations is the goal of cultivating PSTs' capacity to reflect on practice so that they may learn from it (Loughran, 2002). However, the means for supporting this development of reflection varies from one professional education program to another (Ziechner & Liston, 1996).

One means for developing PSTs' capacities to reflect on practice is using practice-based materials (cases, lesson plans, student work) and using the kinds of thinking cultivated using the materials to examine PSTs' practice. In this chapter I discuss the ways that I structured an assignment in which PSTs constructed a dilemma-based case on their *own* teaching (a problem of practice) and reflected on it. The assignment required PSTs to identify a problem of practice, construct a case that captures the problem, and reflect on the case using knowledge of teaching and learning. I developed the case assignment in response to my dissatisfaction with my capacity to cultivate PSTs' reflection on their practice in my methods class. Although my PSTs had been able to engage in thoughtful reflection when considering practice

embedded in published cases and video (the practice of others), I struggled to engage them in the same kind of thinking on their own practice.

From my experience of working with my PSTs, I found that reflecting on *other's* practice was not sufficient for cultivating reflection on one's *own* practice. The nature of my PSTs' reflections on their practice, and their bewilderment when I pressed them to reflect, uncovered this difference. I needed my PSTs to both be able to reflect on their practice and to recognize the importance of this type of reflection as a means of learning from practice if they were going to take this skill into their careers as teachers (Loughran, 2002; Schön, 1983).

Vignette: Sharing Practice in Mathematics Methods Class

Gil exclaimed as he entered class, "half of my kids were absent today and you would not believe what happened! THE most quiet students raised their hands to answer my questions. I couldn't believe it!" Gil's class of 42 highly capable students had constructed math problems and shared solutions that day instead of using textbook tasks. Gil's colleagues responded to his surprise by relating to how they got students to respond to questions. As I asked questions about the mathematics, students' questions, and Gil's instruction, I received quick responses or more stories from the classroom that related to the event. After a few moments the conversation waned and one PST summarized, "Sometimes students just decide to talk. It's probably because there was more time for them to talk with half of them gone."

Gil's sharing of his surprising event was similar to many that PSTs shared in methods class. My purpose for having them share was for PSTs to use the ways of examining practice cultivated using practice based materials to make sense of their practicum experiences. Yet, what usually transpired was PSTs typically shared stories of their practice with little detail, which were difficult for others to question, and the group moved to drawing conclusions based on little reasoning. Neither Gil, nor his colleagues, raised issues examining multiple perspectives or considered implications for their teaching. The discussion of Gil's surprising event, and subsequent missed opportunities to make sense of his practice, made me keenly aware that even though we had developed skills to examine other's practice, the PSTs needed to reflect on *their* problems of practice so that they could learn from their teaching. However, as illustrated in the vignette above, story sharing seemed to serve a different purpose for PSTs than I had intended.

It seemed that for the PSTs, their purpose of sharing surprising events and problems of practice seemed to focus on assuring themselves that their teaching experiences were similar and therefore normal. Certainly it is

important for PSTs to feel reassured when learning to teach. Yet, if they were going to learn from *their* practice, they would need to learn how to reflect on their practice. My dilemma was how to focus PSTs' inquiry into their practice in ways that assured sharing of practice was an opportunity to learn. As Loughran (2002) asserts, "It is [PSTs'] ability to analyze and make meaning from [their] experience that matters most – as opposed to when the teacher educator … shares the knowledge with the [PSTs]" (p. 38). I had not done a good enough job supporting the PSTs' reflecting on their teaching. I needed ways to structure reflections so that PSTs' were doing the analysis of their practice and learning from it.

Normalizing Problems of Practice and Then What?

Recognizing that I needed to learn how to support PSTs to do their own inquiry, I engaged in reading literature documenting when teacher communities pursued learning from practice. Little and Horn (2007), examining potential learning opportunities when teachers engaged in sharing their practice, described a phenomenon of normalizing experiences. Normalizing, or suggesting an event was "an expected part of classroom work," reassures teachers and cultivates solidarity among colleagues. Similarly, I found my PSTs normalized problems of practice by sharing series of stories as a means of reassuring each other that surprises and problems happen to all of them.

Normalizing was common in Little and Horn's examination of teachers' discussions, yet what was critical to productive discussions was the nature of the discourse after responses of normalizing. In my methods class, PSTs normalized Gil's surprise with their sharing of similar experiences, then they concluded that the reason the students' actions changed that day was solely based on something that was out of their control—student attendance. Little and Horn offer another path, one in which teaching becomes an "object of collective attention" and teachers engage in an intertwining process of: (1) normalizing practice; (2) inquiring into the specifics of practice (teaching, learning, and content to name a few); and (3) generating principles of teaching. This process was one I thought could be vital to developing the capacity of my PSTs to reflect on practice and learn from it.

Reflection as Inquiry into Practice

Little and Horn's work provides images of generative discussions of problems of practice. However, they are not explicit about *how* PSTs might learn to dig into issues of practice. Scholars' considerations of productive reflection are particularly insightful on what might be entailed by Little and Horns' inquiring into the specifics of practice (Davis, 2006; Loughran, 1996,

2002). Essential to notions of productive reflection is Schön's (1983) ideas of focusing on a problem of practice with a process called framing and reframing, *e.g.*, bringing to bear multiple perspectives on the issue.

Davis (2006), building from Loughran (2002) and Schön's (1983) work, suggests that productive reflection for PSTs requires practitioners to frame the problem considering the learner, learning, subject matter, assessment, and instruction. The use of multiple frames allows for viewing the problem from different angles. It involves untangling the complexity of an issue by reasoning about the facets of the problem and considering potential resolutions that inform subsequent practice (Schön, 1983). Davis' work suggests these frames for considering practice are overlapping in expert practitioners' thinking and in a teaching and learning context. As a result, she advances that PSTs' productive reflection would connect or integrate frames to makes sense of the complexity of practice. Loughran, (2002) also connecting to Schön's (1983) work, claimed that productive reflection involves learning that is generative for subsequent practice.

To advance how a teacher educator may support PSTs reflection I designed a specific assignment (to be described in the next section) for my methods class and ask the following research questions, informed by the work on reflection. (1) To what degree do PSTs consider multiple frames when reflecting on practice in their cases and reflections? (2) To what degree do they integrate these frames to consider the complexity of teaching and learning? (3) What opportunities to learn from practice does the case assignment present for PSTs?

Background

The case assignment took place during the winter term of a one-year professional education program and was based on PSTs' teaching experiences in their fall practicum. Similar to Schön's (1983) notion of "problem setting," my PSTs were instructed to focus on a dilemma of practice that caused some sense of uncertainty, surprise, or presented a problem (Table 1). Because cases were used across their courses, the assignment connected to ways of capturing practice the PSTs had experienced. We collectively agreed that their cases should describe events that did not have clear-cut solutions, require consideration of multiple issues to make sense of the event, and provide insights on teaching and learning applicable beyond the specifics of the case (Carter, 1999; Shulman, 1992). Accompanying the assignment was a reflection on the case grounded in course work material and the conceptual framework of the professional education program.

Table 1. *Case Assignment*

Case Details
   The case should vividly focus on your dilemma, provide enough detail
      to see the issue, and not loose the reader in detail.
   The case should not solve the dilemma but elicit conversation.
   The narrative should include 2-4 questions to reflect on after Reading
      the case.

Reflection Details
   Discuss the potential of the case to develop yours and your colleagues'
   understandings of the professional knowledge needed for teaching
   components: knowledge of content, knowledge of general pedagogy,
   knowledge of pedagogical content, and knowledge of context
   (Grossman, 1990; Shulman, 1986). How did you tap into your
   developing knowledge base in these areas to develop and think through
   this dilemma of practice?

Lee Shulman (1987) and colleagues' work on the professional knowledge base for teaching was central to the framework for PSTs' professional educational program and their methods courses were steeped in ideas of reform practice. However, typical of students in teacher education, many of the PSTs understood learning to teach as a technical craft and came to their professional education program having considered only a direct instruction model of teaching (Grossman, 2005). About half of the PSTs were skeptical of the reform pedagogy described in text/video cases and articles. However, a few PSTs openly rejected their "apprenticeship of observation" in traditional school mathematics and stated that they were willing to try on these new ideas.

Data Sources and Analysis

Nine mathematics PSTs' cases and reflections were analyzed for this study. The analysis of PSTs' cases was completed in a number of phases. First, I read each case noting ideas to initially identify evidence for each frame. After reading and noting passages that related to the frames I went back to examples of Davis' (2006) coding of data and compared, realigning my ideas about each frame as needed (Strauss, 1987). Then I returned to PSTs' cases, completed analytic summaries to reduce the data, and identified PSTs' central dilemmas. Finally, I catalogued areas in the text related to the professional knowledge base and frames ((i) learner and learning, (ii) subject matter, (iii) assessment, and (iv) instruction).

In my summaries I distinguished between ideas that were emphasized in a case, noting the amount of detail and development of the idea, and frames that were merely mentioned, but not developed. I also recorded what ideas were advanced about subsequent practice. To answer my three research questions I memoed, based on my analytic summaries, on the themes across the PSTs' cases, connections or lack of connection across frames, and ideas on subsequent practice (Miles & Huberman, 1994). Finally, I distilled the ideas into a table to compare across cases to identifying patterns in the ways PSTs were using the frames, knowledge base and other issues that seemed central to the PSTs' reasoning that were outside of the frames or knowledge base. Some of these issues included consideration of equity and professionalism.

Many times PSTs' ideas could be related to more than one frame. For example, when a PST discussed issues of engaging students using manipulatives, he wrote about the mathematical ideas being considered, students' understandings using the tools, his assessment alignment with his instruction, and instructional decisions he made. This example was coded with learner/learning, subject matter, assessment, and instruction. I also noted whether these ideas were simply considered as a sequence of ideas or linked to inform the PST's sense making.

Findings

All nine cases presented problems PSTs faced in their teaching. Six of the PSTs' explicitly stated that they experienced a sense of surprise, frustration, or puzzlement, about the situation when it happened in their classroom. Three PSTs suggested that the assignment helped them uncover that there was not an "easy fix" for what had happened and that they needed to learn more about making sense of students' thinking and instructional strategies. Learning to teach was not just a technical craft but required deep consideration of teaching and learning. One PST suggested that originally he thought the problem he faced while teaching was a "simple, small" issue, but as he reflected on all that was at play he realized that his experience called into question his understandings and values presenting a "philosophical conundrum" (PST3).

Problems of Practice

Most striking in the cases was that all PSTs considered issues related to reform mathematics. Cases illustrated PSTs' struggles with reform pedagogies. For example, using group work for problem solving, asking students to share solutions, or using manipulatives to model mathematical relationships presented problems or a sense of uncertainty for PSTs.

Four of the nine PSTs explicitly discussed that their beliefs about teaching and mathematics were challenged as they reflected on their use of reform practices. One PST's experimenting with group work uncovered that he was

"a beginning teacher, who [was] in the middle of the transition from traditional teaching to educational reform" (PST 2, p. 2). Another PST's case writing exposed what he called "biases" about particular ways of instructing mathematics. "I had to get over my … belief that manipulatives were a crutch…a less sophisticated way of engaging with mathematics" (PST4, p. 4) He also suggested how he had changed his ideas, "What I should be … emphasizing that everything we did … is completely legitimate in the mathematics world. My students are attacking problems in the same way a 'real' mathematician would" (p. 3). This PST examined his beliefs about mathematics. As result, his understanding of the nature of mathematics and teaching mathematics were considered and a new understanding of both emerged.

The case assignment was a vehicle for considering reform as more than a new menu of strategies to use in their teaching. PSTs were able to consider multiple issues, reflect, and revise how they might approach their dilemma, clearly inquiring into their practice. Ball (1997) notes one aspect of inquiry is that it "strive[s] to make a new idea viable, getting it on the table for examination, trial, and debate… not pushing it as 'the way' [or] 'selling it'" (p. 94). PSTs' writing weighed the benefits and drawbacks in light of a variety of sources of information. As a result, no one made a "sales pitch" in their case suggesting that they had the "silver bullet," nor was reform the magical hope for student learning. PSTs played out their thinking, albeit at varying levels of complexity, to examine their beliefs and understandings of teaching and learning mathematics.

Using Multiple Frames to Analyze Cases

To address my first two research questions on PSTs' use of frames to reflect on practice, I found that PSTs' cases were grounded in complex issues, and as a result most PSTs shared how they wrestled with student learning, the content, instruction, and other issues. The reflection that followed the case allowed the PSTs to unpack the case and to analyze what was at play in the problem. Table 2 summarizes the topics addressed and the frames considered in the cases.

PSTs used a number of frames to make sense of their dilemmas of practice (Table 2). The most common frames were learner/learning and instruction. Unlike the nature of discussions of practice in methods class, it is evident that PSTs considered a number of perspectives in their reflections on practice. Even though not all of these ideas were integrated, which Davis (2006) considers critical to productive reflection, seven of the nine PSTs had some degree of integration either in the case or the reflection. Integrating frames in reflections resulted in a number of PSTs being able to consider affordances and drawbacks of instructional moves and potential changes. The

case assignment structured PSTs reflection on practice such that they had
opportunities to share their practice and learn from it.

Table 2: *PSTs Dilemmas of Practice and Frame for Analyzing Dilemma*

	Cases of:	Frames in Case & Reflection
1	Traditional math teaching learner "how" verses teaching why, learner needs both.	Learner/Learning, Content, Instruction, Content knowledge, Pedagogical Content Knowledge, Professionalism
2	Problem solving in heterogeneous groups – high and low students working together.	Learner/Learning, Instruction, Pedagogical Knowledge
3	Cultivating mathematical discourse- individual needs and whole class learning	Learner/Learning, Instruction, Pedagogical knowledge, Equity and Special Needs students
4	Using Algebra tiles to solve equations – valuing multiple representations in class and assessment.	Learner/Learning, Content, Instruction, Assessment, Knowledge of: Content, Pedagogy, Pedagogical Content
5	Teaching without *just* showing procedures –using Algebra tiles as means to manipulate equations.	Instruction, Knowledge of Context, Other Teacher's Instruction
6	Maintaining cognitive challenge and modifications for ELL students	Learner/Learning, Instruction, Assessment, Knowledge of pedagogy and context, Equity, Professionalism,
7	Meeting students' needs and engaging them in contextual learning	Learner/Learning, Content, Instruction, Assessment, Knowledge of Content and Pedagogy
8	Using students' solution sharing to guide whole class discussion	Learner/Learning, Instruction, Knowledge of Pedagogy and Context, Professionalism
9	Teaching conceptually – shifting students' practices and expectations	Learner/Learning, Content, Instruction, Knowledge of Pedagogy and Pedagogical Content

As I analyzed cases, I saw that many PSTs were healthy skeptics of reform and had seen the value of reflecting on practice. However, not all PSTs came to understand *how* to examine practice from multiple perspectives. A few PSTs' reflections considered a limited number of perspectives, were vague in attempts to frame their dilemmas, or discussed frames as a sequence of considerations rather than considering how perspectives interacted. One PST's case focused on a new instructional practice and was framed by a perspective outside the author's locus of control. This framing resulted in drawing conclusions about students' performance based on a narrow perspective. Perhaps more importantly, the PST's case lacked specificity and asserted certainty in ways that made it difficult for others to suggest reframing the case.

Reflecting on Practice to Learn from Practice

The main aim of reflection, as advanced by Schön (1983), is to learn from practice by problem solving on events of teaching. PSTs' cases and reflections enacted what Schön calls "reflection on action" a chance to look back on practice without the stress of in-the-moment decision-making. To address my third research question, what opportunities to learn from practice does the case assignment present for PSTs, a number of PSTs directly talked about their opportunities to learn based on the assignment. In fact, five of the nine PSTs' cases and reflections cited explicitly that their study of practice provided a chance to think more deeply about the problem, to consider "what I value, what I am skilled at, and what I need to work on," (PST3) to think more about "specific instances… [instead] of a lesson as a whole" (PST9), to do more than just remember what they did, but to analyze their practice.

A number of PSTs juxtaposed the written reflections on lessons constructed immediately after their teaching to the case assignment. One PST noted, "for my [reflection on the day of the lesson] I didn't really step-back and think about what I could have done differently from the beginning. I was already thinking about what I was going to do for my next lesson to make up for lost time" (PST7, p. 3). A number of PSTs suggested that the time and distance away from the immediate "what will I do next" type questions and the chance to consider different perspectives and issues were crucial to their learning. PSTs drew on text presented in their courses and the input of peers reviewing drafts of their cases. One PST noted that when he considered different sources for framing his case he was faced with inconsistent answers to problems of practice. His case and reflection brought the uncertainty of teaching and learning to light and required him to weigh the ideas. He noted that he had to "learn how to balance these inconsistencies to build [his] teaching style" (PST2, p. 3). The PSTs seemed to realize the purpose of reflecting on *their* practice, not just for storytelling, rather as an opportunity to learn from their practice.

Reflection on Practice to Inform Future Practice

Reflection on action supported all PSTs to think about their future teaching. Each PST's reflection made some reference to future practice or changes that the PST would make in subsequent teaching. However, and perhaps more important, was the fact that some PSTs were able to think more critically about their practice, to abstract and see the dilemma in the case not just as an instance in their teaching, but to consider what was to be learned in terms of generalizable ideas. PSTs' grappled to understand the issues at play when trying on reform. The process of reflecting pressed them to abstract from the case so that they had a repertoire of responses ready. This type of thinking was observed especially when PSTs' reflections integrated frames to consider the complexity of practice. It seems that in this deliberation of multiple frames, PSTs were able to specify details of practice and emerge with what Little and Horn (2007) consider principles of practice. This was most notably captured in PST4's reflection, when he discussed his biases uncovered by reflecting on his use of manipulatives. PST4 saw his prior perspectives on teaching and learning mathematics as potentially limiting access for student learning. He advances a principle that all students have the right to learn and it is a teacher's responsibility to not limit these opportunities. Another PST's reflection exposed his principle that teaching should attend to why mathematics works and why it is important as a means to construct "higher quality mathematics education for students in my class" (PST1, p. 3). PSTs' case assignments supported PSTs discovering principles that were tacit in them thinking and made the principles explicit so that their future practice might benefit.

Implications for Cases as Knowledge-of-Practice in University Professional Education

The PSTs' cases assignment presented the opportunity to learn from practice and uncovered problems of practice situated in trying on reform based practices. As a whole, the PSTs were able to frame their problems of practice in complex interactions using multiple frames. However, from this one assignment I am not suggesting that PSTs will always be able to reflect on practice to learn from it. In fact, my analysis uncovered that a few PSTs, to varying degrees, saw the assignment as a chance to narrowly examine their problem and assert with certainty what was at play in their practice. To cultivate and sustain PSTs' capacity to reflect on practice they need more opportunities to come to see that they could frame their problems of practice in multiple ways. As a teacher educator, I could easily frame PSTs' practice by commenting on their reflections; however, I would be falling prey to Loughran's (2002) warning that I raised at the beginning of this chapter. I would be inquiring into PSTs' practice rather than the PST.

Cochran-Smith and Lytle's (2001) work from almost a decade ago, and Little and Horn's (2007) recent work on teacher learning communities, both suggest the potential of teachers learning from practice. In their work, learning from practice becomes a knowledge base or resource from which teachers draw. Similarly, the PSTs' cases could become a knowledge base from which PSTs can learn. To further explore the utility of this assignment I plan to employ the PSTs' cases each year as a part of the university professional education curriculum. Using PSTs' cases and carefully attending to future PSTs' analysis of these cases will support a knowledge-of-practice (Cochran-Smith & Lytle, 2001). As this way of learning from practice becomes more normative this type of reflection on practice may disrupt the conventional socialization to teaching and thus change what teachers talk and think about to develop a narrative of inquiry (Ball & Cohen, 1999).

Endnote

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