Preservice Teachers' Learning from an Online, Video-based, Mathematics Professional Development Resource

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This article presents the findings of a study of preservice teachers' unstructured engagements with an online, video-based, professional development resource focused on mathematics teaching and learning. Volunteer preservice teachers were invited to engage with the online resource and their reflections on their experiences were recorded in individual and focus group interviews. The findings reveal how the preservice teachers engaged with the resource, and what they learned about the teaching and learning of mathematics from their interactions with the resource. Here we present elements of those findings that reveal the participants' learning.

Keywords: preservice teacher learning, professional development

In previous publications, the first author has reported on a study of her own teacher education practices involving teaching with video-based examples of classroom practice derived from her own mathematics education research studies and her own practice (e.g., Towers, 2007). In the research reported in this article, however, we turn our attention to preservice teacher learning from professionally-developed video resources focused on mathematics teaching and learning. In addition, unlike much of the published literature that reports on (preservice) teachers' engagements with multimedia cases in structured group environments (principally teacher education classrooms) or with a facilitator (e.g., Boling, 2007; Borko, Jacobs, Eiteljorg, & Pittman, 2008; Lampert & Ball, 1998; Masingila & Doerr, 2002; McGraw, Lynch, Koc, Budak, & Brown, 2007), the research study reported here deliberately gathered information about preservice teachers' *unstructured* engagements with, and learning from, multimedia professional development resources. The rationale for this choice of design for the study is that practicing teachers are most likely to engage with freely available, online, professional development resources in their own time, probably alone, and with little or no formal organizational support. Hence, this study attempted to investigate how newly graduated preservice teachers approached such resources (and what they learned from them) when given free rein to explore them without structured guidance. We also anticipated that, given the unusual nature of these preservice teachers' teacher education program (which we will describe briefly in a moment), their unstructured engagement with, and learning from, professional development materials might be different than that reported in the literature as typical learning from such materials. The preservice teachers selected for this study had participated in an inquiry-based teacher preparation program structured to help them develop practical wisdom—a form of knowledge oriented to ethical action, which is the grounding of the knowledge, capacities, and dispositions that are at the heart of reflective,

inquiry-based practice[1]. Learners within this program are asked to interrogate their own learning, reflect deeply on their practices (of learning and teaching), and be active participants in gaining new knowledge about teaching. At the end of their two years in the program, graduates are used to searching for, and creating, their own materials for teaching and learning about teaching. The research on which this article draws examines how graduates of this form of teacher education engage with professional development materials of all kinds, and in the particular dimension reported here we examine their engagements with one particular online, video-based resource. The core resource used for the study was the Reflections© resource, published by the National Council of Teachers of Mathematics (NCTM) and freely available on their website (NCTM, 2010). Our research questions included: To which kind of professional development materials do preservice teachers gravitate as they strive to learn to teach mathematics? How do preservice teachers engage with particular professional development materials? What do they learn about mathematics and mathematics teaching as a result of their engagement with various professional development materials?

Theoretical Framework—A Phronetic Approach to Teaching and Learning

The broad theoretical perspective framing this research is centered on Aristotle's conception of *phronesis* (Dunne, 1997, 2005). As Coulter and Wiens (2002) note, phronesis does not easily translate into English, but a common translation, and one adopted by the teacher education program that the participants featured in this writing experienced, is practical wisdom. Phronesis is a particular kind of knowledge—one oriented to action, and specifically ethical action; action oriented to the good (Coulter & Wiens, 2002; Lund, Panayotidis, Smits, & Towers, 2006; Ricoeur, 1992; Wall, 2003). Phronesis hence requires an interaction between the general and the particular—for instance, not only knowing general principles of classroom management, such as consistently applying rules of behavior, but understanding why, on this particular day with this particular child in relation to this particular task, rules may need to be modified. This kind of knowledge contrasts sharply with a technical perspective on teaching, which

> seeks to *extract* from [practice] a rational core that can be made transparent and replicable. Typically, this entails disembedding the knowledge implicit in the skillful performance of the characteristic tasks of the practice from the immediacy and idiosyncrasy of the particular situations in which it is deployed, and from the background of experience and character in the practitioners in whom it resides. Through this disembedding it is supposed that what is essential in the knowledge and skill can be abstracted for encapsulation in explicit, generalizable formulae, procedures, or rules—which can in turn be applied to the various situations and circumstances that arise in the practice, so as to meet the problems they present. (Dunne, 2005, p. 375)

[1] A detailed account of the philosophical, theoretical, and structural dimensions of this teacher education program can be found in Phelan (2005).

A phronetic approach to teaching calls forth from practitioners a set of capacities and practices that differ strongly from those valued within such a technical rationalist frame (Dunne & Pendlebury, 2002). This cluster of practices is commonly referred to as an inquiry-based approach. Many of the practices now clustered within the term inquiry-based have a basis in Dewey's philosophy of learning and, in the field of mathematics education, can be traced through the constructivist movement and are reflected in the 'reform' movement spearheaded in North America by the US-based National Council of Teachers of Mathematics (NCTM, 2000). The kinds of knowledge, practices, and dispositions typically attributed to inquiry-oriented teachers that have relevance for the data presented in this paper include responsiveness to students and facility with listening, a commitment to exploring student thinking as well as skill in probing and making sense of students' ideas, knowing how to 'teach for understanding' including capitalizing on students' multiple solution strategies, and a commitment to continued professional learning about practice (Alberta Learning, 2004; Lampert 2001; Lampert & Ball, 1998; Moscovici & Holmlund Nelson, 1998; NCTM, 2000).

Teacher Learning and Professional Development

The research on (mathematics) teacher development is broad and covers such concerns as the content and/or pedagogical knowledge base of teachers and preservice teachers (Ball & Bass, 2000, 2003; Hill & Ball, 2004; Kotsopoulos & Lavigne, 2008; Sosniak, 1999), issues of teacher and/or systemic change (Cochran-Smith, 2005; Loucks-Horsley, Hewson, Love, & Stiles, 1998), the influence of teachers' understandings of student thinking (e.g., Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996; Jacobs, Franke, Carpenter, Levi, & Battey, 2007), the impact of teachers' beliefs on their classroom practices (Lloyd, 1999; Raymond, 1997; Vacc & Bright, 1999; Wideen, Mayer-Smith, & Moon, 1998), the various roles and influences of initial teacher preparation (Darling-Hammond & Bransford, 2005), (successful) features of teacher professional development (Bredeson, 2003; Wilson & Berne, 1999), and dimensions of teacher learning including, with particular relevance for this article, such dimensions as the role of curriculum materials in teacher learning (Ball & Cohen, 1996; Ball & Feiman-Nemser, 1988; Collopy, 2003; Davis & Krajcik, 2005; Remillard, 2000). Within this broad body of literature is a subset that concerns itself with the use of case studies (most recently, multimedia case studies) as tools in developing professionals' thinking. As our research utilized a set of multimedia case studies and we draw conclusions about teacher learning within this context, we focus primarily here on the current literature in this domain.

Teacher Learning from Multimedia Case Studies of Practice

As Masingila and Doerr (2002) acknowledge, the research literature dealing with teacher learning from multimedia case studies is "rather limited" (p. 238) and Brophy (2004) notes that "relatively little systematic research has been conducted on the feasibility and effectiveness of various types and uses of video for various teacher education purposes" (p. x). Despite our collective paucity of knowledge about teacher learning from multimedia resources, there is published literature that promotes the use of multimedia in teacher education (e.g., Davis & Krajcik, 2005; Jaworski, 1989). In an informal publication directed to teachers, Jaworski (1989) promotes the use of videotape for professional development. Her

publication proposes ways in which teachers can initiate and sustain discussion about video recordings taken from their own classrooms, or professionally-produced recordings. However, there are also cautions about video use in teacher education. Pimm (1993) describes two common responses from adults (both teachers and teacher educators) as a result of being shown a piece of classroom videotape, which he has labeled *televisual* and *intimidated*. A televisual response is one that is based on the expectations that people have when a TV monitor is introduced into the room. Pimm suggests that on these occasions students tend to become passive—they have been conditioned by their usual experiences of television viewing to expect to be entertained, not stimulated intellectually. Pimm suggests that this response, whilst understandable and explicable, detracts from the value of using video. Brophy (2004) concurs and suggests that many educators employing video as a tool in teacher education claim that teachers need to be given clear purposes and agendas for viewing video and that their experiences need to be structured and scaffolded so as to support attainment of specific learning goals. As Pimm also notes, beginning teachers are often intimidated by carefully selected extracts featuring experienced teachers and apparently highly motivated and responsive pupils. He reports that this intimidation leads to defensiveness and that beginning (and more experienced) teachers often respond by criticizing the teaching—a judgmental stance also noted by Brophy (2004). As Ball (1995) notes, however, the challenge is one of developing in (beginning) teachers a stance that is less simply evaluative of the teaching they see and more analytic of practice.

Given the particular nature of the teacher education program in which the preservice teachers we studied had participated, we had questions about whether these preservice teachers would fall prey to these same orientations to multimedia examples of practice. During their teacher preparation program, these preservice teachers had been called upon to view the classrooms in which they had studied as student teachers as texts to be read rather than as sites in which to perform and it seemed to us possible that they would therefore read multimedia representations of classrooms in the same way. Such questions formed the backdrop against which the study reported here was designed.

Other authors have carefully analyzed preservice and/or practicing teachers' responses to multimedia cases of practice and attempted to describe the learning that they have observed. For example, Chieu, Weiss, and Herbst (2009) have created animated representations of classroom events and used these representations to investigate practicing teachers' learning and knowledge. Participants in Chieu, Weiss, and Herbst's study freely explored the multimedia stories and were asked to comment on what they saw as noteworthy events in the episodes. Chieu, Weiss, and Herbst claim that the animations provided opportunities for teachers to share and discuss their common practical knowledge of their profession, and hence learn about different alternatives to a given teaching situation or problem. Copeland and Decker (1996) studied the effects of work with video cases on the meaning that preservice teachers in their study made from classroom teaching vignettes. They also studied the effects of a later (unfacilitated) group case discussion on subsequent meaning-making. Copeland and Decker (1996) concluded that some of the pedagogical topics raised by the preservice teachers were underdeveloped in both the individual and group responses and they speculated on the need for a facilitator or instructor to guide interaction with the cases and to push the preservice teachers' thinking. We also considered, as part of the initial research

design, including a ‘taught’ session with the online video resource base for some of the participants while allowing others to interact with the resource without a facilitator in order to compare their responses and learning. However, we have gathered evidence in other studies (e.g., Towers, 2007) of the role of the teacher educator in helping to shape understandings when working with video resources (though admittedly not with this specific video resource) and here decided to explore only participants’ unstructured engagements with the resource, especially given that most practicing teachers are likely to engage with this particular resource without an instructor or facilitator to guide them.

In their study of preservice secondary mathematics teachers’ responses to a multimedia case study of practice, Masingila and Doerr (2002) reported that participants were prompted to reflect on some of the dilemmas and tensions found in teaching. In particular, the preservice teachers focused on the difficulties encountered when trying to use student thinking and in following their own mathematical goals in a lesson. Similarly, in their extensive analysis of using multimedia case studies of teaching practice in initial teacher education, Lampert and Ball (1998) describe their experiences of designing a multimedia environment that would support preservice teachers’ learning about practice and help them to learn how to learn from their own practice as teachers. Lampert and Ball also raise an important issue concerning the design of multimedia resources—how to be sure that they are, in fact, educative. The research reported here contributes to this discussion by showing how the particular professional development resource used in this study served to educate a small group of preservice teachers and by offering a set of initial implications for those studying educative curriculum materials for initial teacher education.

Method

Data Collection

Six volunteer participants, five female and one male, who were new graduates of an initial teacher education program, were interviewed twice, once before being introduced to the Reflections© resource and once after. All interviews were video- and/or audio-taped (one participant declined to be videotaped). In the initial interview, questions centered on the participants’ experiences before entering the teacher education program, their experiences of learning through (and practicing teaching through) inquiry in the program, their ideas about inquiry-based teaching and learning, and what they sought from professional development materials and resources for teachers and how they typically searched for and engaged with those materials. Following their initial interview, participants were referred to the link on the NCTM website that connects to the Reflections© professional development resource. This resource contains, in hyper-linked form, what Ball and Cohen (1999) call “materials of practice” from several classrooms. There are videotaped classroom excerpts, interviews with the featured teachers, samples of student work, planning notes, questions for reflection, and so on. Participants were asked to engage with the materials in any way they wished, and after several weeks they were contacted again for a follow-up interview to discuss their experiences of engaging with the resource. Data from interviews with three participants have been used to construct this particular article and these three participants are introduced in the

following section. Only three of the six participants were chosen for inclusion here because we find it helpful to limit the number of 'characters' with which readers must try to become familiar within an article-length manuscript. The contributions of the remaining participants were consistent with the contributions detailed here (see 'Preservice Teacher Learning' section later) and their inclusion would not have added significantly to the analysis nor altered the conclusions drawn.

The Participants

The participants in the research study reported here were, technically, preservice teachers, however the research was conducted after all requirements for their teacher preparation degree program were completed. The participants therefore existed in an in-between space—not yet engaged in the act of full-time teaching and yet already released from the constraints of an education program. Some participants had already secured teaching contracts for the Fall and knew where (and which grades) they would be teaching, others had secured an initial contract with a school division but had not yet been 'assigned' a placement, and others had yet to secure any form of future employment as a teacher. This timing was deliberate. We sought to understand what kinds of perspectives *graduates* of the teacher education program brought to their hunting and gathering for professional development materials once they were no longer directly influenced by teacher educators and/or teacher education curriculum requirements.

Ocean was a mature, elementary-route student who had spent many years in the corporate world before choosing to enter the teaching profession. She reported finding the business world populated by people who lacked creativity, and wanted to work with young children in an effort to foster the creativity that they bring to learning. She indicated a desire within her teaching to "integrate all subjects and have [the] flexibility to create something bigger." She had found a comfortable home in the inquiry-based philosophy of the teacher education program and felt that it aligned with how she would like to approach her own teaching. She had had the opportunity to explore inquiry-based teaching and integrating curricula in her field experiences during her teacher education program, despite being paired, in one of those settings, with a teacher who did not practice this way herself and who was wary of the approach. Ocean talked with great excitement about these experiences of enacting (mathematical) inquiry with children. She appeared confident about her own mathematical capacity, though she expressed frustration that most of the mathematics methods texts and websites she had encountered provided ideas for teaching various mathematical concepts but little in the way of the historical context of how these ideas had developed in the first place, an element that she considered critical to the development of a sound inquiry that integrated mathematics with other subject areas, rather than treating it as a series of isolated concepts to be mastered. She also noted that, even in the field experience she had had in a school that prided itself on its inquiry-based curriculum, mathematics stood apart from the other disciplines and was treated as an 'add on' rather than fully integrated into the inquiry that absorbed all the other teaching subjects.

Trevor had an undergraduate degree in English and had completed his teacher preparation program in the Secondary Language Arts route. Most of his student teaching had been in

Language Arts, though he had completed his major field experience in a middle school and had taught Grades 7 and 8 Mathematics there. Trevor reported being "bored senseless" watching the students "do the textbooks" during his observations of mathematics in his field experience classroom, so when he had the opportunity to teach he devised an inquiry project. He had not been entirely satisfied with the experience, claiming that he had not taken enough time to really develop it properly and discussing other factors that had inhibited its success. It appears that Trevor, in his first experience of inquiry-oriented teaching, had encountered one of the great challenges of this approach—the difficulty of predicting exactly what concepts would be covered by the inquiry. Trevor noted that the inquiry project covered "bits and pieces" of the chapter in the textbook that his partner teacher had wanted him to teach, but had also covered "way more than that." Trevor had also been tripped up by the requirement to still have the students do weekly quizzes on the material from the textbook they would have been covering had their regular teacher still been leading the class and these quizzes revealed gaps between what the partner teacher wanted covered and what students were actually learning. Trevor reported feeling that he had "failed with those expectations" and remembered swearing that he "would never do it again." Having had some time to reflect since that experience, though, he also noted that he now felt he would approach mathematics teaching again through inquiry but that he would be more deliberate about infusing specific mathematics concepts into the inquiry. Trevor came to this research project, then, believing that inquiry-based teaching and learning is the "right theory, it's just that it's difficult to practice."

Anastasia was a mature, elementary-route student who had an undergraduate degree in Engineering and a previous career in chemical research. Like Ocean, Anastasia felt relatively confident in her mathematical abilities, but had opted not to aim to teach secondary sciences or mathematics because she didn't want "to teach Math 10 three times in a day." Instead, she felt drawn to the "interdisciplinary things you can do at the elementary [level]." In her field experiences she had practiced in two contrasting schools (in terms of teaching philosophy), and had felt constrained in the second one (where her major teaching had taken place) to conform to the traditional teaching that was the norm there, however she reported feeling that inquiry-based teaching and learning made "the most sense" to her and was clearly keen to practice inquiry in her own classroom. Anastasia already had a confirmed teaching appointment at the time of the research study, and was looking forward to teaching Grade 5 in the Fall of that year.

Though we had hoped to interview all participants together for their second interview in order to prompt more discussion about the materials, some participants had been unable to join the group interviews and were therefore interviewed separately (though we reiterate that all engagements with the Reflections© resource were conducted individually in the participants' own time). Trevor participated in two individual interviews, while Ocean and Anastasia participated in individual initial interviews and a joint second interview. Due to technical difficulties with the website, some of the video components of the upper grades material in the Reflections© resource base had been inaccessible during the study period, so most participants had viewed the primary grades materials. In the interviews, participants mainly referred to the Grade 3 materials so we offer here a brief description of the tasks and materials contained in that component of the resource.

Reflections© Grade 3 Materials: The Doubling Pot

Like each set of the Reflections© resources, the Grade 3 materials contain a detailed lesson plan, videotaped excerpts from pre- and post-lesson interviews with the classroom teacher, sets of questions for reflection[2] that link to brief lesson video clips, samples of student work from the featured lesson, and a set of questions designed to encourage engagement with the mathematics targeted within the lesson. It is not possible to access a video of the whole lesson or even a list of the clips in chronological order (an issue which was noted as problematic by some research participants)—video clips can only be accessed by reflection theme. In the lesson, the Grade 3 students are asked to decide whether they would rather be given one thousand coins or five coins and a magic doubling pot, into which the five coins can be placed, which doubles its contents (however, the students are told that the doubling pot will only work ten times). They therefore need to figure out whether doubling five coins to get ten, then doubling ten to get twenty, etc., for ten iterations will result in more or less than one thousand coins. The students are given a worksheet that asks them to first state which option they would choose, and why. There follows an instruction to model the problem using base-ten blocks, and a T-table with ten lines and two columns headed 'In' and 'Out.' Finally, there are some questions for reflection on the worksheet: What did you notice? Did you make the right choice? How do you know? The brief video clips—linked to reflection questions for the viewer—show extracts from several phases of the lesson including the teacher introduction, small-group working, and whole-class discussion of the problem.

Data Analysis

Data analysis proceeded in several stages. Though the research team (first author and a number of graduate student research assistants) had gained familiarity with the Reflections© resource materials before initiating the data collection phase of the study in order to guide questioning in the interviews and make sense of the participants' responses and conversations, data analysis began with a phase of detailed re-familiarization with the entire resource base. Following this phase, interview data were transcribed and initial familiarization with the data was initiated by reading through the transcripts in their entirety several times, and by watching and listening to the original video and/or audio recordings to ensure accuracy of transcription and to add notes to the transcriptions concerning gestures or facial expressions that informed the way in which certain ideas were communicated by participants. In addition, this phase enabled clarification of the group interview transcript, where it was initially difficult to infer the speaker during overlapping conversation on the audiotape. Next, transcriptions were annotated to highlight contributions that were pertinent to our focus on teacher engagement with, and learning from, the Reflections© resource. These annotated passages were then analyzed, against a background of teaching as phronesis, for ideas and themes that were repeated in multiple transcripts, and also for outlying or idiosyncratic responses. For example, a phronetic approach to teaching emphasizes the

[2] The questions for reflection for each set of grade-specific materials are structured around the following topics: appropriateness of the tasks, teacher and student discourse, evidence of learning, teacher decision making, and mathematical ideas.

significance of the particular, as described earlier. Hence, we paid attention to whether the participants tended to draw on generalized theories and norms of teaching practice as they sought to understand the materials with which we had asked them to engage, or whether they sought to understand why and how particular actions were significant in context. For example, as we show later when we discuss what the participants noted about lesson transitions, these participants consistently reflected on how student thinking was preserved (or dissipated) through lesson transitions, rather than on conceptions of lesson transition as primarily a classroom management concern (as it is often presented in teacher education textbooks and primers for new teachers). In the final phase of analysis these coded contributions were developed into a narrative that tells the story of these participants' engagements and learning. The paragraphs above that introduce the participants are excerpted from these developing narratives.

To deepen our analysis we also drew on the work of Fong, Percy, and Woodruff (2004) who have identified four lenses through which they claim that teachers (both novice and experienced) view videotapes of exemplary teaching practice. These are (a) a content lens, wherein viewers essentially watch the vignette as a student of subject matter being taught in the vignette with the purpose of learning more about the content being presented rather than the pedagogy, (b) a form lens, wherein viewers watch as 'teacher-technicians', often concerning themselves with management of the learning activity rather than underlying purposes and functions, (c) a surface-level media lens, wherein viewers watch as a video producer might, commenting on the setting, teacher's appearance and video presentation, and (d) a pedagogy lens, wherein viewers process what they see at a deep level, drawing on knowledge of learning theory and/or subject matter knowledge and focusing on underlying processes and functions of the action. Fong, Percy, and Woodruff claim that those using the pedagogy lens are acting as 'master teachers.' We used Fong, Percy, and Woodruff's framework to determine the lens through which the preservice teachers were viewing the video material and then interpreted these lenses through the theory of phronesis to understand the underlying orientation that the preservice teachers may have been bringing to their interactions with the resource. In the next section, we present the four major themes of focus for the preservice teachers, as derived from the above described data analysis processes.

Preservice Teacher Learning

In this section we analyze examples drawn from the data corpus that illustrate how the preservice teachers engaged with the Reflections© resource and what they learned from those engagements regarding teaching and learning. The interaction with Reflections© allowed the participants in this study to identify deficiencies in their own teaching practices and areas for their own growth in teaching mathematics, to learn strategies for lesson planning, to reflect on teacher decision-making and lesson transitioning, and to learn new strategies for assessing student understanding. Each of these aspects of their learning is addressed below.

Reflecting on Deficiencies and Identifying Areas for Growth in Teaching

Ocean expressed how engagement with the resource allowed her to reflect on her own deficiencies and possible improvements she could make to her own teaching.

> *O*: For me, I think what I like the most about that resource…was listening to the teachers and watching the students interact.…It would start to highlight points that I go "oh, I'd like to try that", "oh, I'm not that good at that", you know?...More than the [reflection] questions for me, it was the listening to the videos and seeing where possibly I could improve something myself.

Trevor revealed that, as a result of engaging with the materials, he learned about a specific deficiency in his own teaching.

> *T*: Well, I thought my biggest problem...is that I'm not concise enough in my direction....I saw a bunch of times [on the video]...where I thought, "Well, this is taking too long and I know what she's trying to get to but it's taking too long" and I thought that was almost like the same thing as videotaping yourself. It's a different way of practice by watching someone else....I saw her kind of go that way [*gesticulating a circuitous route*] to get to her point instead of straight, which is something that I fear myself doing. That's why I found that beneficial; I could see how these traps got laid. You are trying, she was trying to be so careful that it took her too long to cover the details.

As well, Trevor described his recognition that reflection was difficult for young children and identified it as an area with room for improvement in his teaching. Here he reflects on evidence of students' attempts to respond to the reflection question at the end of the worksheet:

> *T*: I found out that most of the kids just didn't answer it, or if they did, they didn't actually, like they [used] words but they weren't answering the question. I thought that that was interesting 'cause that's something we've, I think, I've talked a lot about [*in the teacher education program*], is reflection is good, but how do you teach reflection?...That's something that we need to...work on in the future is teaching kids to reflect....When I saw that, I was kind of like, "well, that's something that I would struggle with."

Each of these examples show that a primary concern for these preservice teachers was the underlying function of the observed teaching in terms of student learning, an orientation consistent with Fong, Percy, and Woodruff's (2004) pedagogy lens. For example, we note that Ocean's concern as she listened to the teachers was "watching the students interact" and these two processes—teaching and student interaction—were clearly connected for her. Similarly, Trevor showed concern for a deeper consideration of the theoretical idea of reflection on action—a perspective emphasized within the teacher education program. He was concerned with the underlying challenge of how one might actually teach others (in this case Grade 3 students) to reflect on their problem-solving processes.

Lesson Planning

Trevor also drew attention to his learning about a novel structure for lesson planning revealed by the materials. In particular he noticed that part of the plan asked the teacher to predict what the students would find easy and difficult in the proposed lesson. He reflected

that while this may have been an idea he had encountered before somewhere in his preparation to teach, it was not one that had stuck with him until he saw it enacted (and observed the ensuing lesson) in the Reflections© resource base.

> *T*: I liked all the questions that they asked for the lesson plans, like the way they had that laid out. This type of a format made sure that you had all your bases covered and really if you know that then...you are...more prepared. [In] particular, what will my students find easy, what will my students find difficult? I thought, "That's really a clever way." That struck a chord with me. Those are smart ways to prepare your lessons.

Ocean also commented on this aspect of the lesson planning structure adopted in the materials, noting how this structure focuses the teacher's attention on expectations for student understanding. In both these examples, then, we see the preservice teachers adopting a pedagogy lens. The aspect of the teachers' planning activities that drew their attention was this particular device, a mechanism designed to focus attention on student conceptions and misconceptions of the topic and hence, learning.

Transitioning

Ocean and Anastasia talked about how observing the various transitions of the lesson was particularly helpful.

> *O*: The area that I found the most helpful was not even the content because there are lots of flows of lessons where things that I've already tried, but it was more the transitions. Actually it was the area that I found, for me, was "oh yeah, maybe I'm not spending enough time here", or maybe, "oh, why did she go back and do that three times, you know, maybe there's a need here."...So one way that she was [transitioning] in this Grade 3 [lesson] is [when] someone responded and said "I understand it" then that table went and she identified that person as being a key...And then she said, "Now who else understands?" So she didn't let a table go.
>
> *A:* Until they had a focal point within that group.
>
> *O:* So I learnt something. So what I see with this [resource] is what we will learn is two or three gems each time we look at this.

Trevor also described how Reflections© allowed him to explore lesson transitioning and consequently provided him with the opportunity to recognize areas for growth in his own teaching:

> *T*: The transition one, the one that I thought was not very well done was, the end result was good, it was exactly something that I would have done too, which is why I picked it up, was to go from the group work to the carpet in front of the table and then she asked...the smart kid—the only one that ever talks, Lewis or whatever his name was—to hold onto his thoughts...but by the time they got there his thoughts were clearly gone. I thought that was interesting. It's something that I thought of, actually, to go back to...my planning of knowing when to cut things off and how am I going to actually get twenty-five kids from here to there in a time where it won't feel like a new lesson by the time you got there?

In these excerpts, and interpreted through Fong, Percy, and Woodruff's lenses, we see the preservice teachers' concern about how to prompt and preserve student understanding through various lesson transitions. They did not focus on how to manage behavior and movement efficiently during transitions, and even though Trevor commented tangentially on how long a transition seemed to take (as the students moved to the carpet) his concern about this was not in relation to the potential for disruption and management issues but the potential for loss of students' important mathematical *ideas* during such transitions.

Assessment

Ocean discussed issues of student assessment by recognizing that one of the teachers depicted in Reflections© struggled with the assessment of her own students. The teacher thought some of the concepts would be difficult for her students but, as the lesson unfolded, it became clear that this was not necessarily the case. While it was true for some of the students it was not true for others. This recognition reinforced for Ocean the realization that even experienced teachers struggle to know what each individual student knows and can do. She commented, "Okay, for you [the Grade 3 teacher featured] it's hard as well."

In addition, through their engagement with the resource, Anastasia and Ocean recognized how a child's language has a place in assessment. They each noticed how the grade three teacher gathered information about each child's understanding by writing down on individual peel and stick papers brief excerpts of what each child had said during conversation or whole group discussion:

A: I loved the practical stuff. Like when they [the interviewers on the Reflections© video] asked her [the teacher] about the peel and stick labels. That's always been a challenge for me, [be]cause I get so absorbed in what [students] are doing and trying to be out there and...participating in what they are doing that at the end of the lesson when I was student teaching, you know, I'd be asked "So,...what were the comments you heard and what was this person doing?" and I'm thinking "Uhm, yeah, I talked to that person" and this whole peel and stick label thing in the conferring book [with] the tab sections for each child, I thought "Okay, I'm writing that down."

O: ...because, it's an assessment for you to know what you want to do in the next class but it's also there at the end. And that was what I found with these, you know, is jotting down notes, right? What kind of format to use. And every teacher does a different thing, but stickies you can just [tapping as though she was writing a note].

A: And you can find them.

O: Yeah, I like that too.

A: And the kid language thing, she said she wrote kid language.

I: Can you say a little bit more about that? [Interviewer]

A: She literally wrote down what the kids had said to her in their words. She didn't say "Oh wow, they understood the doubling concept until they got to the higher numbers" she wrote down what the kids said. And she said "show me what's happening here, you know, what's going on" and then she would literally write down what the kids said to her in the kids' words.

The encounter with Reflections© also compelled Trevor to ask himself important questions surrounding assessment, in particular concerning assessing student understanding.

> *T*: [I wondered] how she could tell from the group discussions how many of them were actually understanding what they were doing....And so I guess, [the resource] helped in the sense that it raised the question for me, "well how do you actually know what these kids are getting?"...So I thought that was sort of a question that arose for me, too, for the group assessment of how do you, aside from something written that you are getting, how do you know how many of them are getting it?...I found [the resource] mostly...beneficial in a way that it brought issues to my attention if not answers.

Again drawing on Fong, Percy, and Woodruff's lenses, we see in these excerpts that all three of the preservice teachers showed deep concern for student *understanding* (not just procedural competence or surface subject matter knowledge), a concern that shows they have integrated theoretical and research-based thinking about mathematics learning into their conceptions of good teaching. Although both Ocean and Trevor did allude to the difficulties associated with ascertaining student understanding—Ocean when she noted that the Grade 3 teacher seemed to find that difficult and Trevor when he noted that the resource did not provide answers but rather further questions for him—they showed that they were processing what they saw and heard deeply, looking for and commenting on the underlying processes that lead to understanding. Hence, despite, recognizing the challenges of teaching for mathematical understanding each of the preservice teachers were willing to dwell on student understanding as their primary concern. Anastasia, in particular, showed a nuanced interpretation of the idea of assessing student understanding when she commented on how the teacher recorded students' own words on sticky notes. Anastasia noted that the teacher didn't just say "Oh wow, they understood the doubling concept until they got to the higher numbers" but that she actually asked the students to show her what was happening in the problem and wrote down what the kids said.

Discussion: Learning from Professional Development Resources

Borrowing from Ball and Feiman-Nemser (1988) who claim that preservice teachers should be taught "how to learn from using published curricular materials" (p. 401), we extend that idea to contend that preservice and practicing teachers should also be taught how to learn from professional development materials. As Copeland and Decker's (1996) findings show, it cannot be assumed that teachers will engage in a sophisticated manner and learn anything of significance just because the materials with which they are interacting are intended to be educative. Drawing on fundamental work in the domain of pedagogical content knowledge (Shulman, 1986), Davis and Krajcik (2005) suggest that educative curriculum materials ought to assist in the development of a more integrated and robust knowledge base for teachers, including knowledge of how to teach the content and knowledge of how to help students understand the authentic activities of the discipline. We believe that the participants' engagements with the resource show that they were able to learn from the resource and that what they learned was oriented to student thinking and understanding and sound teacher practice. This study therefore provides evidence of what a small group of teachers learned from their unstructured interactions with a professional development resource that is freely available to teachers. However, it is also significant, we think, that these beginning teachers

had participated in a teacher preparation program that specifically aims to foster life-long learning within the profession of teaching and that focuses explicitly on unpacking students' prior learning experiences and teaching them how to learn through inquiry (Phelan, 2005). While we cannot claim a direct correlation here, continued research with students and graduates of this program is indicating that an inquiry-oriented education can help to shape new teachers who are engaged and thoughtful and whose classroom practices reflect their beliefs (Towers, 2008, 2010). In part, then, the Reflections© resource may have served to surface the preservice teachers' tacit knowing as developed during their teacher preparation program, in addition to prompting new learning (such as Anastasia's recognition of the importance of documenting students' own words when assessing their understanding of a concept). In the remaining sections of this paper we discuss the level of sophistication of the participants' engagement with the resource and position their engagements as a form of Dewey's (1908/1932) imaginative rehearsal of action.

Sophistication of Engagement

In contrast to Copeland and Decker's (1996) concerns, which we mentioned earlier, that the participants in their study often did not develop topics and ideas to a significant level, in this study participants showed a relatively sophisticated level of engagement with the materials. For example, though Copeland and Decker (1996) criticized some of their participants for focusing on "limited" ideas, or, when they addressed important ideas focusing on them in limited ways, the participants in this study showed a tendency to focus on significant ideas concerned primarily with promoting student thinking about mathematics. For example, the issue of transitions between lesson elements surfaced a number of times in both individual and group interviews. Two such examples were described in the previous section. While lesson transitions could be considered a quite trivial management concern, the way in which these participants addressed the issue reflects concern with a deeper reading of the phenomenon of transitions.

Trevor was one of the participants for whom lesson transitions seemed an important aspect of his learning. He noticed that in one of the video episodes the teacher had asked a boy to "hold onto his thoughts" while she had the class move from small groups to a whole class setting sitting on the carpet at the front of the room, and that by the time everyone was settled the boy's thoughts had "clearly gone." Trevor turned his experience of watching student thinking 'disappear' into a question for his own practice: "How am I going to actually get twenty-five kids from here to there in a time where it won't feel like a new lesson by the time you got there?" This emphasis on student thinking (rather than behavior management) suggests that, educated within an environment that privileges phronesis, preservice teachers are able to develop an orientation that helps them focus on sophisticated elements of teaching practice (such as privileging student thinking). It is also interesting to note that Trevor considered the resource beneficial because it "brought issues to [his] attention if not answers." This is a sophisticated engagement with a professional development resource for a preservice teacher, as it is usually assumed that new teachers are more concerned with solutions, techniques, and tips for the classroom rather than with actively seeking out and

valuing complexities and questions.[3] Similarly, Ocean, in her reflections on lesson transitions, picked up on a transitioning strategy that emphasized the importance of ensuring that at least one member of each table group had an understanding of the problem before releasing that particular group of students to work on the problem. This is a transitioning strategy that positions student understanding as a primary concern for the teacher. Ocean (and for that matter, Anastasia, who seemed to also have noted and understood the value of this strategy) commented that in the Grade 3 lesson "[a student] responded and said 'I understand it' then that table went and [the teacher] identified that person as being a key...And then she said, 'Now who else understands?' So she didn't let a table go [*Anastasia completes the sentence:*] until they had a focal point within that group." This insight into Ocean's interpretation of classroom events (and perhaps we may suggest Anastasia's, too) suggests that she notices and privileges strategies that enhance student learning rather than those that simply keep a classroom running smoothly—a lens that Fong, Percy and Woodruff (2004) would suggest is a sophisticated (pedagogy) lens. As noted previously, Fong, Percy, and Woodruff (2004) claim that those using the pedagogy lens are acting as 'master teachers.' While participants in our study did occasionally comment on elements that might suggest they were using a 'form' lens, we contend that for the most part, and as can be seen in the previous examples, these preservice teachers were analyzing the underlying purposes of the pedagogy and orienting themselves to inquiry and supporting student learning (and hence using the more sophisticated 'pedagogy' lens). Though we did not pre-test the participants' competencies in these domains before introducing the Reflections© materials, we are confident that the materials prompted significant realizations and learning for these preservice teachers, as evidenced by the animated ways in which they described their engagements and emerging recognitions (e.g., "transitions…was the area that I found, for me, was 'oh yeah, maybe I'm not spending enough time here'" (Ocean on what she learned about her own lesson transition procedures by watching the teacher on the video), "[the resource] helped in the sense that it raised the question for me, 'well how do you actually know what these kids are getting?'" (Trevor on the importance of understanding student understanding), and "she would literally write down what the kids said to her in the kids' words" (Anastasia on the assessment mechanism used by the teacher in the video). The Reflections© materials, then, afford possibilities to help preservice teachers surface, reflect upon, and extend their learning about teaching.

Imaginative Rehearsal of Action

In our analysis of the data we noticed that the participants often referred to themselves (or to the non-specific but inclusive 'you' or 'one') as though they had been the one teaching the

[3] While some readers may question whether Trevor's instinct to raise a question for his own practice can be said to represent learning, we reemphasize the theoretical framework underpinning both this research and the teacher education program within which these research participants learned to teach. A phronetic orientation to teaching and learning emphasises the importance of reflection on practice, and the constant effort to raise questions about one's own practice in order to guide learning and development of practice. From this perspective, Trevor's engagement with the resource has prompted a significant question about student learning and this is a critical step in his own learning. As the first author has shown elsewhere (Towers, 2008, 2010), new teachers' orientation to a questioning and inquiry-based approach to their own and students' learning provides a basis for strong initial teaching practices.

lesson. Sometimes their language use flipped back to 'she' or 'her' for the teacher mid-sentence. For example, Trevor, in reflecting on his own deficiencies in direct teaching (described above) noted that "You are trying, she was trying to be so careful that it took her too long to cover the details." The participants seemed to take ownership of the teaching and learning they observed, even going so far as to project themselves into the video and see themselves as the teacher. Trevor, for instance, commented that

> *T*: You *tend* to look for the things that you are worried about seeing in yourself and so...you notice what it looks like and I think that's been a lot, most teachers' problems, or at least mine [is] that I don't know what I look like when I'm up there and I have a feeling that the mental image is not quite accurate. So I thought that was really good for like a reflection type of a tool in that sense that you can actually see what you are doing [*note the use of 'you' here*].

This reflective action is a form of what Dewey (1908/1932, p. 302) calls "imaginative rehearsal of action." Such deliberation "is actually an imaginative rehearsal of various courses of conduct" (p. 303) and therefore such moments offer teachers a space in which to consider possibilities and reflect on how they might act and respond in a similar situation.

For these participants, sometimes the imaginative rehearsal took the form of a kind of internal dialogue with the 'characters' on screen. With her comment, "Okay, for you it's hard as well. It's not just hard for me to perceive what twenty-one to thirty kids get out of this and where they really [are] at," Ocean reveals a fairly common speaking pattern that emerged in the interviews we conducted wherein the research participants revealed to us the kind of internal dialogue they had been having with the teachers and students who appeared on the video clips. Our impression, gained during analysis of the data, is that the preservice teachers were responding to the videos in the same way that they may have responded to a live observation during a practicum field placement—they were interrogating the texts (videos, lesson plans, lesson debriefings, etc.) and participating in a 'dialogue' with, and about, the teaching/teachers and learning/learners they were viewing. Again, this instinct may be a result of the kind of teacher preparation program these preservice teachers have experienced—one where the field experience classroom is primarily considered a text to be interpreted, not a space to replicate existing practice or simply apply theory. The 'dialogues' though are interesting, given that they are not even being presented in real-time—they were being reported in group or individual interviews some time (up to several weeks) after the engagements with the particular section of the resource may have occurred. We see these, then, as significant to and for the participants. Clearly, these dialogues remained with the participants over time and were presented to us as powerful descriptions of the ways in which the participants had engaged with the resources.

Implications

That the participants had placed such emphasis on imaginative rehearsal of action begs the question of whether the classroom examples offered in a resource such as Reflections© should represent exemplary teaching or whether a "flaws and all" approach is more helpful. There is disagreement in the literature on this issue. While both folk wisdom and some

research evidence (e.g., Smith & Diaz, 2002; McCurry, 2000) would suggest that exposing teachers to video models of exemplary teaching is a powerful and efficient form of professional development, Fong, Percy, and Woodruff (2004) and others (e.g., Bereiter, 2002) doubt whether teachers commonly recognize exemplary practice when they see it. We acknowledge that there may be value in offering preservice (and practicing) teachers opportunities to experience, through videotape or some other means, practice that is exemplary. As Ball (1990) and others (see e.g., Howey & Zimpher, 1999; Lampert & Ball, 1999) note, unless preservice teachers have experience of an alternative model of teaching to the traditional one that many of them have experienced in their own schooling, they cannot hope to be able to enact a different conception of what it means to teach. However, we do not believe that preservice (or practicing) teachers necessarily need to experience how such an alternative conception can be enacted while they are *in a school setting*. Both the context of teacher education itself (see, e.g., Phelan, 2005) and an immersion in "materials of practice" (Ball & Cohen, 1999) such as is offered in the Reflections© resource can offer alternative conceptions of teaching that are rich and complex and both are worthy of further consideration.

While it is clear that much of the material included in the Reflections© resource was interpreted by our participants as being representative of good, inquiry-oriented teaching, we did ask our participants to comment on whether they felt they could learn from elements of the resource that might be considered to represent less than exemplary practice. Anastasia noted that "you can learn a lot about how you don't want to word stuff, or how you don't want to present it, absolutely" while Ocean was less sure that she would want to view a resource that showed poor practice. In contrast to the perspective she brought to the rest of her reflections on the resource, her interpretation of our question focused on the mechanics of how the teacher might organize a lesson. She commented that, "I think what I liked is the teachers speaking at the end of what worked or didn't work in a lesson. But...I don't think a poorly run lesson would be something that I would stay on." This was one of the few instances in which a participant adopted a 'form' rather than 'pedagogy' lens (Fong, Percy, & Woodruff, 2004) to interpret the Reflections© materials. While, as we noted earlier, Pimm (1993) suggests that videotapes of exemplary practice can lead the viewer to feel intimidated and to respond with defensive criticism of the teacher, we feel that, for the most part, the participants in this study did not adopt such a perspective and instead worked to analyze the practice, in particular in terms of its capacity to enhance student understanding of mathematics. This analytical rather than evaluative perspective is, as Ball (1995) has noted, challenging to promote in preservice education, however it is important to develop resources and teacher education practices that support such development. We believe that the Reflections© resources have the potential to occasion analytical perspectives, although given the particular participants with whom we engaged in this study it is not clear to what extent beginning teachers educated in a less inquiry-driven and inquiry-oriented program would orient themselves in the same way to this resource. Further research with a wider sample of preservice and practicing teachers would be required to tease out such complexities.

Further, Ball and Cohen (1996) note that educative curriculum materials (and by extension we claim educative professional development materials) should offer "concrete examples of what students' work might look like, what reasoning might underlie students'

work, and what other teachers have done in similar situations" (p. 8). Our study shows that the Reflections© materials offer such examples, and that the participants were able to learn from these examples and demonstrate a relatively sophisticated understanding of teaching practice through this engagement. In addition, Ball and Cohen (1996) also recommend that educative materials should offer "concrete illustrations of the nature of student understanding important at a given point, and how other teachers have reached this point" (p. 8), features we do not believe are immediately foregrounded in the Reflections© materials but that might reasonably be added to, or made more explicit within, the resource. Additional research that uses the Reflections© online resources in comparison with other similar materials (such as Chieu, Weiss, and Herbst's (2009) materials) might help elucidate precisely which features of a professional development resource are the most significant for promoting sophisticated learning about the nature of students' mathematical understanding and how to occasion it in diverse classrooms.

Conclusion

Understanding teaching as a form of phronesis—practical wisdom—calls on practitioners to make sound judgments (in and about practice). This study has shown that educating new teachers to orient themselves to sophisticated concerns of pedagogy (such as concerns for student learning and understanding) rather than technical management issues (such as classroom control) is possible and that such orientations show themselves in relation to video-based, online, teacher professional development materials. To be oriented to the complexities of student learning and understanding is the ground of sound judgment, wise practice, and hence phronesis. Further, our analysis reveals that the Reflections© resource is capable of providing a context for surfacing and, at times, occasioning such learning.

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