

UNPACKING A CASE STUDY: UNDERSTANDING TEACHER EDUCATORS AS THEY UNDERSTAND THEIR PRE-SERVICE SECONDARY TEACHERS

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The challenges facing those who seek to prepare mathematics teachers are well established in the literature. Most of the research to date has focused on the perceptions and understandings of pre-service teachers, but not on the perceptions and understandings of teacher educators. In this study, we explore how teacher educators understand their pre-service teachers as these pre-service teachers attempt to make sense of teaching through the investigation of a multimedia case study of practice. We found that in using the case study, teacher educators elicited pre-service teachers' thinking about the complexities of the teacher's role in small group work, about the limits of their abilities to extend lesson ideas, and about the value of revealing teacher's reflections.

Introduction

Mathematics teacher educators face several practical problems in their work with pre-service teachers: finding sufficient high quality classrooms for placements, developing robust understandings of mathematics among pre-service teachers, supporting their reflections on students' mathematical thinking, and developing images of practice that go beyond "telling clearly." The number and intricacy of theories attempting to model mathematics teaching has increased substantially over the last two decades (Koehler & Grouws, 1992). However, it is only recently (e.g., Cooney, 1999; Cooney, Shealy & Arvold, 1998; Simon, 1995) that theories of teacher development are beginning to emerge that go beyond theories that describe models of effective teaching to theories that explain the nature and the development of teachers' knowledge.

Such theoretical work appears to hold promise for informing the practical work of teacher educators. Yet much of the current research focuses primarily on pre-service teachers' mathematical content knowledge, their beliefs, and their pedagogical content knowledge. There is very little research on the teacher educators who work with these pre-service teachers. This study intends to contribute to the emerging theories of teacher development by examining the work of teacher educators as they understand the development of their pre-service secondary teachers. In this study, we investigated the nature of the implementation of a classroom-based, multimedia case study that was used by teacher educators as part of the professional preparation program of pre-service teachers. We seek to understand how teacher educators understand their pre-service teachers as these pre-service teachers attempt to make sense of teaching through the investigation of a multimedia case study of practice.

Theoretical Framework

Our theoretical framework is grounded in two areas of research related to teachers' professional development. The first area involves research regarding the complexity of classroom environments while the second involves research regarding the use of case studies in supporting the development of effective practices within such complex settings. The complexity of classroom environments presents particular problems for the novice teacher whose limited experience and knowledge make it difficult to effectively observe the complexity of interactions that occur, often with great rapidity, in a typical classroom. Beginning teachers are often concerned with issues of classroom management and the planning of lessons as important priorities. They may not focus on the subtleties of understanding student thinking or the nuances of facilitating group work and class discussion or the tradeoffs inherent in teachers' decisions.

The complexity of these interrelated issues is addressed by Simon (1995) as he describes mathematics teaching as the cyclic interrelationships of teacher knowledge, thinking, decision making, and mathematical activities, all of which are influenced by the teacher's understanding and evolving hypotheses about students' learning. Cooney (1999) notes the importance of examining the contexts through which teachers develop and use their knowledge. He states that "whatever lens we use to describe teachers' knowledge, that lens must account for the way in which knowledge is held and the ability of the teacher to use that knowledge in a reflective, adaptive way" (p. 171). Teacher educators are faced with the challenging task of simultaneously meeting the practical needs and concerns of their pre-service teachers while supporting their professional development along lines that will deepen their mathematical knowledge, develop their understanding of children's reasoning, and enhance their ability to reflect upon their decisions and actions in the classroom.

The second perspective that is brought to this study is the notion of the case study as a vehicle for understanding complex practices such as law, medicine, engineering, and (more recently) education (Barnett, 1998; Merseth, 1991). In developing approaches for using case studies in the professional preparation and development of teachers, broad and varying appeals are made to the potential of case studies. These appeals range from the potential for providing paradigmatic exemplars of practice to providing a means of understanding theoretical principles, while bridging the gap between theory and practice (Sykes & Bird, 1992). Others have suggested that the primary purpose of case studies is to support the development of critical analysis and informed decision making. A key characteristic of a case study is that it is embedded in the context of teaching (and schooling) with all its concomitant complexity, ambiguity, and incomplete information. As Feltovich, Spiro and Coulson (1997) have argued, the knowledge base of teaching is an ill-structured domain and as such is best learned by a criss-crossing of the landscape through the study of cases of practice. It is precisely within the complex, ambiguous, and partially understood context of practice that teachers have to make reasoned judgments and decisions for action. Learning through cases studies, it is argued, promotes teachers' understanding of the

complexities of practice and of the need to become more analytical about the data of classroom practice (Wassermann, 1993). It is this paradigm—that case studies are a site for reflection and analysis by those preparing to become teachers—that guides the analysis in this study. We wish to examine how teacher educators understand the thinking of pre-service teachers as they reflect on and analyze a case study of practice.

Methodology and Data Analysis

This qualitative case study is part of a larger research project on the use of multimedia case studies by mathematics teacher educators to support the professional growth and development of pre-service secondary mathematics teachers. The teacher educators participating in this study were all experienced faculty, one at a small college and two at mid-sized universities. For purposes of anonymity, all results are reported in a single gender. The pre-service teachers were graduate and undergraduate students in the final stages of their preparation for full-time student teaching. Most were involved in classroom observations and had some limited teaching experiences. All of the participants in this study had a copy of the CD-ROM "Ranking Data to Make Decisions: The Case of the Sneakers Purchase" (Bowers, Doerr, Masingila & McClain, 1999). These multimedia materials were intended to capture the artifacts of practice in a 7th grade class of 23 students in an urban public school over the course of a one and a half day lesson.

The purpose of the case study lesson was to engage middle school students in the collaborative analysis of real world data in an effort to make a mathematically viable group decision about the most important factors to consider when purchasing a pair of sneakers. The problem first involved identifying criteria that might be used when deciding on a pair of sneakers to be purchased. The students were then asked to rank order the criteria from most important to the least important. After each of the six groups ranked the list of eight criteria, students were challenged to develop a system to aggregate all of the groups' lists into one final, ordered list of criteria. The case study teacher then called upon groups of students to present their ranking systems to the class. The case study materials included background information on the school, the teacher's lesson plans, the teacher's anticipations of the lesson and her reflections after the lesson, video of the whole class discussions and small group interactions, a scrolling transcript that was linked to the video, copies of student work, and related mathematical activities.

The teacher educators had a facilitator's guide that suggested some ways that the case study could be used and contained a set of discussion questions that organized the issues of teaching and learning mathematics around four themes: planning, facilitating group work and whole class discussion, understanding student thinking, and mathematical content and context. These four themes were intended to guide and support the reflection and analysis by the pre-service teachers without overly constraining or dictating how the case study would be used by the teacher educators. Each teacher educator used the materials for a minimum of three to four class hours over at least a two week period.

Both the teacher educators and the pre-service teachers completed questionnaires that were designed to understand (a) how the case study was used and the goals of the teacher educator, (b) the background and experiences of the pre-service teachers, and (c) the salient issues in the case study for the teacher educator and the pre-service teachers. In addition, we conducted semi-structured interviews with the teacher educators to probe the issues that were raised through the use of the case study materials and to better understand how the teacher educator perceived the relationship of those issues to the professional growth and development of the pre-service teachers. The pre-service teachers completed several written assignments based on study questions from the facilitator's guide and an essay on the characteristics of effective teaching. The questionnaires, interviews, assignments and essays constituted the data corpus for this study.

The analysis of this data was conducted in three phases, using inductive qualitative methods. In the first phase, we coded the responses of the teacher educator and pre-service teachers to the open-ended questions on their respective questionnaires (e.g., "For me, the most valuable part(s) of this case study investigation was . . .") to identify emerging themes for the pre-service teachers. In the second phase, we analyzed the students' written assignments and essays for instances of these themes and other possible themes that may not have been addressed in the responses on the questionnaires. We also analyzed the teacher educators' interviews, seeking elaborations and instances of these themes and identifying key issues from the teacher educators' perspectives. In the third phase of our analysis, we compiled profiles on the use of the case study by each of the teacher educators and identified those themes and issues that were critical for the teacher educator or for the pre-service teacher. These profiles then became the basis for interpreting each perspective in light of the analysis done in the first two stages.

Results

We report the results of our analysis in terms of the issues that emerged from the use of the case study by each of the teacher educators. In the first teacher educator's investigations with the multimedia case study, she was very open-ended in her approach to the case study. She described her pre-service teachers as very "autonomous" learners and simply directed them to "use it how you want to but if I were you I wouldn't watch the follow up reflection yet, today at all, until later when we're using this." This teacher educator gave her students these materials as a case for them to investigate from their own perspectives, with only the suggestion that they refrain from looking at the case study teacher's reflections until after they have discussed the lesson in the case. Two central issues emerged for this group of pre-service teachers. First, the pre-service teachers expressed concerns over the case-study teacher's interactions with one of the small groups of students. The pre-service teachers felt that the teacher did not understand what the group was doing and needed to spend more time with that group. They felt that the teacher did not probe deeply enough into their thinking, as she did with some other groups. Furthermore, they found that this lack of probing was a mismatch

with the teacher's professed belief in the value of listening to students in order to move the lesson forward.

The second issue that emerged for this group of pre-service teachers was related to the judgements that they were forming about the case teacher's decisions. These pre-service teachers became somewhat more tentative in their judgements about the teacher as their analysis of the case progressed. They wanted to see all the other groups, not just the three selected for the case study; they wanted to know more about what happens next; they expressed a need to have "the whole picture." They noted that "she has so much to do" and that "it is hard to run a classroom in that way." The teacher educator saw these responses in terms of how the pre-service students were beginning to "see the complexities" of the classroom.

The second teacher educator intended to "emphasize the value and importance of anticipating students' thinking" with her pre-service teachers. In this teacher educator's class, the two central issues that emerged were related to anticipating children's thinking and on the interactions between the teacher and the students. For the first issue, the teacher educator directly encountered the difficulties that pre-service teachers have in anticipating children's thinking. The teacher educator had spent a class session focusing on the mathematics of the case study and found that her pre-service teachers had difficulty "thinking about how else middle school kids might solve" this problem. Later, since the case study was only a one and a half day lesson, the teacher educator involved her students in developing the mathematical lessons that would follow, in order to bring out the ideas of "weighted averages." The teacher educator felt that the mathematics of this concept was significant content that her pre-service teachers needed to understand both mathematically and pedagogically. The activity of developing a next lesson revealed to the teacher educator the pre-service teachers' "beliefs in action." She found that they would suggest, for example, that the lessons needed to mix different modes of instruction or types of assessment, but that they could not articulate why this should be done. The pre-service teachers could not articulate "the criteria that they should use to decide what kinds of activities they should use" to develop the mathematical ideas. The teacher educator reflected that she had not anticipated how revealing of the pre-service teacher's thinking this activity would be, that it was very valuable for her to see them engage in this type of planning, and that she was then thinking about how to bring this in as a component in the methods course.

The second issue for these pre-service teachers and their teacher educator was the focus on the interactions between the case-study teacher and the seventh grade students. The same incident of the teacher's interactions with one group emerged as significant. The pre-service teachers sensed that the case-study teacher was more passive in her actions with that group and that she did not pursue or continue with questions. This led the pre-service teachers to speculate as to why that might be. As with the first teacher educator, this group was not able to come to any definitive conclusion as to the reasons why the case study teacher acted as she did. This then led to a discussion of "what role the teacher might have in the

interacting with the students, what kind of information maybe teachers should be keeping in mind and in relationship to her lesson plan." In this way, the teacher educator acted to encourage a level of analysis of the role and the thinking of the case study teacher among her pre-service teachers thereby supporting their development as practitioners who will analyze and reflect upon their decisions.

In the third teacher educator's classroom, the first issue that emerged was that the pre-service teachers were struck by the reflections of the case study teacher. The teacher educator noted that her pre-service teachers found the reflections "very focused and purposeful." One of the pre-service teachers observed that the case study "gave me a more general but paradoxically more specific idea of what goes into effective teaching practices." The teacher reflections in other video-based materials that this teacher educator had used were "generic comments" and "almost in the order of endorsements." In contrast, the reflections in this case study showed reflective, careful planning and the teacher's thinking about what she thought her students were doing. The teacher educator commented: "We teach them [pre-service teachers] about teaching, but we don't actually show them teachers practicing, reflecting, and evaluating." In other words, the artifacts of the teacher's plans and her reflections went beyond what the pre-service teachers had found in other video materials, observation experiences, and readings. For the pre-service teachers, the reflections appeared to provide an important link to the relationship between the planning and anticipation and the actual outcomes of a lesson. As one pre-service teacher wrote: "She provided insights on what she had expected and what actually happened." Another observed that the reflections "let you know what the teacher was trying to do and what the teacher accomplished. It gave you insights into the lesson." Analyzing the teachers' reflections supported the pre-service teachers in understanding how the case study teacher's planning affected the actual lesson.

The second issue that emerged for this teacher educator and her pre-service teachers focused on the complexities of managing small group instruction. The teacher educator expressed the pre-service teachers' recognition of the complexities and their desire to learn more in one student's comment that "I'm going to try to find somebody that knows how to do that so I can watch it more because it looks pretty complicated." The teacher educator found that the case study helped her to reveal the role of the teacher in interacting with small groups. The pre-service teachers came to recognize that the teacher's interactions were purposeful and that this as an explicit role of the teacher: "They sensed that that was a very purposeful thing on the part of the teacher that was made possible because of the careful preparation in which the teacher thought about what she wanted the students to do and thought about the kinds of expectations." At the same time, the teacher educator found that the pre-service teachers were "anxious [because] they didn't know enough yet to do anything more than appreciate it [the teacher's role]." The teacher educator felt that her students had a greater appreciation of the teacher's role, but since they didn't know enough yet to construct a plan and implement it themselves, many hoped to work in their student teaching with a teacher who did.

In addition to these two issues, the teacher educator reported on the distinctive quality of engagement of the pre-service teachers with the multimedia materials. In addition to the immediacy and the reality of the context, the teacher educator commented that the case study had "incredible depth" and noted that "it takes a long time to unpack it as information and then you have to repackage it into your own thinking for professional training." She anticipated having even better results with her students now that she has experienced the depth of the case study.

Discussion and Conclusions

In each of these three cases, the teacher educators and their pre-service teachers focused on elements in the teacher-student interactions in the group situations. With the first group of pre-service teachers, this was accompanied by more tentative judgments about teaching. With the second group, the pre-service teachers began to analyze why the case teacher might be interacting with the students in this particular way. The shift towards tentativeness in judgment on the part of the pre-service teachers and the awareness that their perspective is limited suggest that these pre-service teachers are beginning to appreciate the complexity and difficulty in understanding classroom interactions. With the third group, the pre-service teachers focused explicitly on the complexity of the role of the teacher and the relationship between her plans and purposes and her subsequent interactions with students. The teacher educator in this instance seemed satisfied that an important step had been taken by her students in appreciating the planning, knowledge and skills that enter into effective interactions with groups. However, she also recognized, as did her pre-service teachers, that the analysis of the case study alone had not prepared them to plan and implement effective group interactions. Overall, we see these responses to the case study materials as leading to an appreciation of the difficulties of a teacher's interactions with groups of students and insights into the complexities of the classroom.

The second group of pre-service teachers and their teacher educator focused on the mathematics of the case. The teacher educator found that the pre-service teachers had difficulty in anticipating middle school student's responses and that their own planning for follow up actions was revealing of the limits of their beliefs about teaching. In this instance, the pre-service teachers were not able to move beyond their own actions to articulate rationales for pedagogical strategies. The third group of pre-service teachers and their teacher educator focused on the case-study teacher's reflections. The case study teacher appeared to provide reflections that were more focused and purposeful to the pre-service teachers, moving beyond general reflections. The analysis of the case study supported the pre-service teachers in the recognition and perhaps valuing of reflections tied to specific teaching. The case study teacher's reflection revealed the link between the teacher's plans and anticipations and the actual outcomes of the lesson.

We make no claims that the analysis of the reflections helped the pre-service teachers become more reflective in their own subsequent practice. Rather, we argue that these instances of analyzing and reflecting on the practice of the case study teacher provided an opportunity for the teacher educator to support the

development of pre-service teachers' reasoning about the complexities of practice. The analyses on the part of the pre-service teachers provided the teacher educators with insights into their students' thinking. The case study materials appear to be effective as a resource that provides a site for pre-service teachers to analyze practice while revealing the strengths and limitations of their analyses to teacher educators.

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