

## **The Interplay Between a Course Management System and Preservice Teachers' Knowledge, Beliefs, and Instructional Practices**

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### **Abstract**

*The multiyear study discussed in this paper focuses on the use of a course management system (CMS) to deliver video clips and interactive mathematics investigations and to support shared reflections in a field-based elementary mathematics methods course. The findings reveal that virtual observations of mathematics teaching episodes in diverse classrooms and participation in interactive mathematics activities and shared reflections via the CMS online discussion board challenged the preservice teachers to reconstruct their beliefs about mathematics teaching and diverse students. Classroom observations and excerpts from the discussion board illustrate how the CMS promoted changes in the preservice teachers' mathematics knowledge and instructional practices. This study gives rise to important findings on the relationships between shared online reflections on virtual observations of mathematics lessons and mathematics teaching in diverse classrooms that are being utilized to inform decisions about teacher preparation programs and the mathematical education of diverse student populations.*

The research reported here examines a preservice teacher initiative whose overarching goal is to respond to the disparities that exist in the mathematics education of diverse students and their dominant culture peers (Strutchens & Silver, 2000) by preparing preservice teachers to teach mathematics for understanding in diverse classrooms. The multiyear study discussed in this paper focuses on a field-based elementary mathematics methods course in which an online course management system (CMS), Blackboard (Blackboard, Inc., 2004), was used to deliver video clips and interactive mathematics investigations and to support shared reflections via an online discussion board. The researcher-instructor designed this study to examine the influences of the CMS on preservice elementary teachers' beliefs and instructional practices. Consistent with the purposes of this study, qualitative and quantitative methods were utilized to address the following research questions: (a) Does participating in a CMS online discussion board promote reflection on mathematics teaching in diverse classrooms? and (b) How do preservice elementary school teachers conceptualize mathematics teaching in diverse classrooms in response to video clips, interactive mathematics investigations, and shared online reflections of mathematics teaching episodes in diverse classrooms delivered through a CMS?

## Perspectives

Written case studies in teacher preparation may be used to consider specific models of teaching and learning, provide opportunities to engage in problem solving, or stimulate reflection (Merseeth, 1996). However, written transcripts and case studies do not present a dynamic portrait of the multifaceted interactions that occur during mathematics teaching and learning. This is further complicated by the fact that the majority of preservice teachers do not have prior experiences in diverse classrooms that they can reflect upon and against which they can assess their own mathematics teaching practices. In addition to limiting their own ability to reflect upon their own teaching practices, preservice teachers' lack of experience can also hinder their ability to analyze the processes of teaching mathematics. It appears that videos are useful in promoting reflection and providing preservice teachers with classroom experiences (McIntyre, Byrd, & Foxx, 1996) by providing illustrations of problem solving and discourse (Corwin, Price & Storeygard, 1996). In a prior study, the researcher examined the use of video clips to provide preservice teachers with experience in observing and analyzing the complexities of teaching and learning mathematics with understanding. Digital video clips of reform-oriented mathematics teaching episodes (National Council of Teachers of Mathematics [NCTM], 2000) available via CDs, provided preservice teachers with opportunities to observe and critically reflect upon teachers and students engaged in problem solving, communication, reasoning, and making connections between mathematics and the real world. The results of this earlier study indicate that critically reflecting on video episodes of mathematics teaching and learning can support the development of conceptually focused, student-centered instructional practices among preservice elementary teachers and develop their ability to engage in reform-oriented mathematics instruction (Dunn, 2002). Because this prior study suggests that preservice teachers develop their models of pedagogical reasoning based upon observations and reflections, it is possible that engaging preservice teachers in shared reflections on video clips of effective mathematics teaching in diverse classrooms will enable them to view teaching from different perspectives and may promote changes in their understandings (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990).

## Methodology

### *Participants and Context*

The methodological underpinning of this study is derived largely from orientations to research that draw attention to the importance of detailed qualitative fieldwork and the observation and analysis of participants in context (Goetz & LeCompte, 1984). During a two-year period the researcher examined the experiences of more than 100 preservice teachers who were enrolled in a field-based elementary mathematics methods course. Recognizing the limitations of a traditional, static, written case study approach, the researcher-instructor created digital video clips that reflect the NCTM *Standards* (2000) and illustrate mathematics teaching for understanding in diverse classrooms. Prior to embarking upon their field experiences in diverse elementary classrooms in urban schools, the preservice teachers access these videos and interactive,

multimedia mathematics investigations (NCTM, 2004) via the CMS and utilize these virtual observations and activities as a springboard for critically reflecting on mathematics teaching and learning. The preservice teachers' record their reflections by posting them to the course's Blackboard discussion board. The discussion board enables the preservice teachers to engage in shared reflections as they respond to one another's postings. In an effort to prod the preservice teachers into reflecting at analytical rather than literal levels, they are provided with a series of prompts designed to stimulate reflection on critical classroom features: (a) the nature of the mathematical tasks, (2) the role of the teacher, (3) the social culture of the classroom (including communication and discourse), (4) mathematical tools (including technology, manipulatives, symbolic notation), (5) student learning, and (6) issues of equity and accessibility (Hiebert et al., 1987).

### **Data Collection and Analysis**

The data for this study included (a) the preservice teachers' shared reflections and responses posted to the CMS discussion board; (b) eight semistructured, open-ended pre and post interviews (Novak & Gowin, 1984), focused on beliefs about diverse students and mathematics teaching and instructional practices; (c) videos of the preservice teachers' mathematics lessons during their field experiences in diverse elementary classrooms; and (d) pre and post questionnaires and mathematics tests designed to assess preservice teachers' knowledge and beliefs. Data analysis focused on the two research questions and took the form of a modified constant comparative method of qualitative analysis (Glaser & Strauss, 1967) in which data were analyzed as they were collected and emerging themes were identified and utilized to guide further data collection. The use of thematic analytic strategies (Spradley, 1979) assisted in developing emergent themes related to the study's guiding questions. These were synthesized within and across the data sources to illustrate important and often complex aspects of learning to teach mathematics. A holistic analysis was accomplished by reviewing transcripts and analyses with the preservice teachers and allowing them to react to analyses and clarify and elaborate on their responses. In order to promote the triangulation of results, qualitative data were supplemented with statistical results from the questionnaires and mathematics content tests.

### **Results and Discussion**

#### ***Interrelations Between the CMS and Mathematics Content Knowledge***

Quantifiable data on the preservice teachers' mathematics content knowledge was measured using a pre and post mathematics test designed to assess conceptual knowledge of the mathematics concepts. Test results indicating that the preservice teachers gained in their mathematical knowledge as a result of engaging in and reflecting on the interactive mathematics investigations delivered via the CMS were supported by interview and observation data. For example, when shown a variety of figures on the posttest and during the final interview, the preservice teachers were able to determine and describe line and rotational symmetry in the figures, describe how the symmetries differed from

one another, create their own figures with line and rotational symmetry, and describe why they are symmetrical. During their mathematics lessons in diverse classrooms, they demonstrated understanding of congruence, similarity, and symmetry using transformations, described the relationships between original shapes and their images in translations, rotations, and reflections, and created mathematical representations from visualizations. A preservice teacher's description of her experiences with the CMS provides an example of how the interactive mathematics investigations enhanced mathematics content knowledge by supporting the development of mathematical understandings: "My own math experiences were memorizing rules. Exploring with the online math investigations gave me a whole new way of looking at the math concepts. Unlike a textbook, for the first time, I was able to finally understand the whys behind the rules."

### ***Interrelations Between the CMS and Beliefs about Teaching Mathematics***

At the onset of the study, a preservice teacher posted to the discussion board: "I think of math in terms of black and white, right and wrong. When presented with a problem, I always use the traditional way to find the answer." The experience of utilizing the CMS to engage in shared reflections on video clips of conceptually focused, student-centered teaching initiated several changes in her conceptualizations about teaching mathematics. Her final posting to the discussion board provides some evidence that the CMS assisted the preservice teachers in constructing an image of teaching mathematics for understanding: "I realize now that teaching math is much more than just giving students the procedures and expecting them all to memorize and apply them." In an early posting to the discussion board, another preservice teacher wrote, "It would make more sense to children if they were taught math in small steps." One of her later postings to the discussion board suggests that the CMS activities prompted her to reconstruct her ideas about teaching mathematics: "The children in these videos have opened my eyes to a very interesting mathematical world. Learning math shouldn't mean just passing a timed test but it should mean increasing knowledge." Another preservice teacher reflected, "I learned a lot from my teaching experience and from the experiences of others through the online discussions. There was a lot of sharing of frustrations but there was always someone who responded who had a similar experience and could offer helpful ideas." Quantitative end-of-study questionnaire data analyses corroborated these results.

### ***Interrelations Between the CMS and Beliefs about Diverse Students***

The findings reveal that the CMS activities challenged the preservice teachers to reconstruct their beliefs about diverse students. Discussion board postings and interview data illustrate that there were several interesting transformations in the preservice teachers' beliefs about diverse students. In an initial discussion board posting, a preservice teacher declared, "We have learned a lot about the constructivist approach but I wonder how much students from minority backgrounds will really be able to gain from this approach." Subsequent CMS discussion board postings illustrate that there were several interesting transformations in the preservice teachers' beliefs about diverse learners. For example, a later posting reflecting on a video clip of a conceptually focused

math lesson in a diverse classroom reveals the element of surprise that lies at the heart of any reflective activity (Schon, 1987): “Wow! These videos totally changed the way I think about diverse children and math. The children in the videos genuinely appeared to enjoy and were succeeding in the math lessons.” In one of her final reflections on a video clip of a classroom composed of bilingual and bicultural learners, another preservice teacher’s posting provides an examples of how the CMS facilitated changes in her perceptions of diverse students: “I really like that the clips let me watch this lesson over again. Each time, I found something else important in this lesson. I was impressed at the children talking about their problem-solving strategies and responding to the teacher’s questions.”

### ***Interrelations Between the CMS and Instructional Practices***

Classroom observations and excerpts from the online reflections posted to the CMS discussion board illustrate how the CMS activities promoted changes in the preservice teachers’ instructional practices. In an early posting to the CMS discussion board, a preservice teacher stated, “It would make more sense to children if the teacher gave them the rules to follow. Knowing your basic facts first is essential for success in math and I feel that is the loophole in teaching math through the new texts.” One of her later postings to the discussion board suggests that engaging in collaborative reflections on virtual observations of mathematics teaching in diverse classrooms prompted her to reconstruct her ideas about teaching math: “I noticed that some of the children who were struggling with English and didn’t seem to understand, did understand, and they showed their thinking with pictures and models. I saw that children don’t learn math in the same way and we should use different approaches to help them build understanding.” Observations of her mathematics lessons during her field experience revealed evidence of changes in instructional practices as she moved toward employing strategies that were focused on engaging all students in constructing mathematical understandings. She reflected in a discussion board posting: “I modeled a lot of my [math] lesson from the teachers in the videos. They related to the students learning because they allowed them to talk about their thought processes and asked them to monitor their thinking and to listen to others thinking.”

### **Conclusion and Educational Importance**

The present study provides some insight into whether and how a CMS can be utilized to promote change in preservice teachers’ beliefs about mathematics teaching and diverse students and influence their instructional practices. The rationale for utilizing a CMS to deliver video clips and interactive mathematics investigations and to support shared online reflections was to offer preservice elementary teachers who lacked prior classroom experience opportunities to observe and reflect on mathematics teaching in diverse classrooms. As noted in this study, the CMS supported shared reflections on virtual observations of mathematics teaching episodes and assisted the preservice teachers in envisioning the complexities and dynamics of teaching mathematics for understanding in diverse classrooms. The results of this study touch on several issues related to preparing teachers for mathematics teaching in diverse classrooms. The

preservice teachers were extremely responsive to using the CMS to access interactive mathematics investigations and video clips of mathematics teaching episodes and engage in the shared process of collaborative reflection via the online discussion board. Returning to the fundamental questions of this study, the CMS activities served as tools for supporting the preservice teachers as they reframed their perspectives on diverse students, enhanced their mathematics content knowledge, and reconceptualized their notions of teaching mathematics. Although they brought to the methods course their own beliefs about mathematics teaching in diverse classrooms, the preservice teachers demonstrated changes in their beliefs about mathematics teaching and diverse students. An important implication of this study is that a CMS can be utilized to assist preservice teachers in reconstructing their beliefs about teaching mathematics in diverse classrooms and prepare them to close the mathematics achievement gap.

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