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Using Video-Based Pedagogy in an Elementary Mathematics Methods Course

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The study explored the impact of using video-based pedagogy on preservice teachers' cognitions about teaching mathematics. The use of video-based pedagogy was integrated into the course, Methods for Teaching Elementary School Mathematics. A variety of written and interview data were collected during the course and, in the following semester, during student teaching. Evidence from case studies of three preservice teachers indicates that they engaged in reflection and reconstruction of their beliefs about how children learn mathematics and moved from a more didactic perspective of teaching mathematics toward a student-centered perspective. Such movement appears to have been influenced by the use of video-based pedagogy.

It is becoming increasingly apparent that learning to teach is a developmental process focused on understanding the dilemmas of teaching (Harrington, 1995). Preservice teacher preparation programs seek to provide experiences supporting this process, primarily through the clinical and field components. However, a number of scholars have questioned the practice of relying totally on these experiences to foster prospective teachers' knowledge (Harrington, 1995).

University course work needs to be connected with the realities of classroom teaching (Kagan, 1992). Such a situation is true for mathematics education. It is necessary to find ways to build links to classroom practice that will provide opportunities for preservice teachers to reorganize and/or replace their existing views of mathematics teaching with those reflecting a more reform-based stance (National Council of Teachers of Mathematics [NCTM], 1989, 1991) in a way that is both intelligible and plausible.

In order to build stronger links between theory and practice, more professional courses now include field-based experiences. However, limitations to such experiences exist (Copeland, 1989; Goldman & Barron, 1990). Not all field experiences offer equal opportunities for shaping the knowledge structures that may be the goals of a teacher education program. In addition, guidance in reflecting upon the meaning of these experiences often may be somewhat haphazard when practice is conducted in real clinical settings. Finally, when novice teachers observe real classes, they often fail to notice — or they misinterpret — many of the signals or cues that experienced teachers use to "make sense" of the instructional environment.

Since the 1980s, incorporating video technology into teacher education curriculum as a way to link theory and practice has been advocated but used infrequently in mainstream teacher education (McIntyre, Bryd, & Foxx, 1996). Since 1990, more studies have been conducted on this topic. While there is not a plethora of research in this area, "there does appear to be a trend toward finding video technology useful in providing additional and richer 'classroom' experiences and for enhancing prospective teachers' reflective thinking" (McIntyre, et al., 1996, p. 182).

Video materials (of both instructional episodes and individual interviews with children) are now available for use in providing brief windows into models and dilemmas of classroom practice and student understanding in mathematics (e.g., Fennema, Carpenter, Levi, Frank, & Empson, 1996; Kamii, 1990; Richardson, 1990; TERC, 1998a, 1998b; WGBH Boston, 1995). Borrowing from literature about the use of written cases in education (Merseth, 1996), a conceptual framework involving three categories provides an organizing scheme for thinking about the use of such video episodes, both in general and in the context of mathematics teacher education:

1. Video episodes may be used as exemplars of generic situations or problems in teaching in order to consider specific models of teaching and learning.

2. Video episodes may provide opportunities to practice analysis and problem solving and to articulate possible courses of action with respect to a particular teaching situation or dilemma.

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3. Video episodes may serve as stimulants to personal reflection, with an emphasis on personal professional knowledge and the individual.

Purpose

The purpose of this study was to explore the use of video-based pedagogy and ways it might impact preservice teachers' cognitions about teaching mathematics. Specific attention was given to whether preservice teachers moved toward a view of teaching mathematics with a focus on facilitating students' mathematical thinking, as opposed to a view of teaching mathematics with a focus on "telling" and on finding right answers. The use of a variety of videotapes were integrated into a course called Methods for Teaching Elementary School Mathematics ("mathematics methods course"). It was the instructor's intent to use the video episodes in each of the three ways detailed previously in the conceptual framework. The theoretical contexts surrounding their use were developed through the use of readings (primarily from Van De Walle, 1994), a consideration of the developmental sequence of selected mathematics content over the K-5 curriculum, and ongoing analysis of selected hands-on activities, explored as ways to teach specific mathematics content.

Context

The mathematics methods course was part of a "methods block" taken by preservice teachers during their senior year (fall 1996). In the traditionally held view of mathematics, the teacher's role is to present the content to be learned and to direct, rather explicitly, the learning process of students. In contrast, the more recent cognitive position suggests that learners create knowledge for themselves by acting on their worlds. The implications for such a view are that the teacher provides students with challenging problems that may be explored collaboratively and through class discussion of students' solutions, with limited intervention by the teacher, since such intervention interferes with meaningful learning (Wood, Cobb, Yackel, & Dillion, 1993). The goal of the mathematics methods course was to stimulate preservice teachers' examinations of their perspectives about teaching and learning mathematics. The emphasis was on helping students make sense of mathematics, building from the premise that the choice of tasks and the discourse related to those tasks greatly influences the learning that may be constructed (NCTM, 1991).

The mathematics methods course had 19 preservice teachers (17 traditional age; 2 nontraditional age; 17 female/2 male; none with a second major in mathematics). The preservice teachers began their education program during their junior year and completed courses focused on child development, as well as a foundations/social studies methods course (each with a field-based component). With respect to mathematics, the preservice teachers either had "tested out of college math" or had met the general college requirement by selecting from several choices, many which were not relevant to teaching mathematics in the elementary grades (e.g., symbolic logic) .

As part of the classwork in the mathematics methods course, a number of different strategies were used to probe for responses to video episodes. Initially, some of the WGBH Boston (1995) videotapes (*Marshmallows* and *Pumpkin Seeds*) were used to address the framework Categories 1 and 2 by focusing preservice teachers' attention on the design and implementation of mathematics lessons. These first few video assignments focused primarily on designing lesson plans within the context of a reforms-based lesson structure that characterized the lesson viewed (see Appendix A for lesson plan structure).

A second set of tapes used to address framework Categories 1 and 3 was selected to accompany a section of the course considering children's development of concepts related to number. These tapes (Fennema et al., 1996; Richardson, 1990) provided examples of (a) the issues and approaches to teaching mathematics about which preservice teachers were reading (Van de Walle, 1996) and (b) ways to conduct interviews in preparation for their own course assignment to interview children. The viewings of short segments were interwoven with other instructional activities, many involving the use of manipulative materials. The major focus for viewing was on how children's concepts about number, place value, and early operations develop (specifically from a Cognitively Guided Instruction or CGI perspective). Preservice teachers were encouraged to try out some of the tasks from the videos with children in their field placements (e.g., interview children solving CGI problems). When this occurred, time was taken for sharing in class as a catalyst to encourage others to experiment.

A third set of tapes (Kamii, 1990; TERC, 1998a, 1998b) used to address framework Categories 1 and 3 accompanied a section of the course that considered the development of children's computational knowledge. The intent was to provide experiences in which preservice teachers saw a variety of children's

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reasoning strategies occurring in the context of whole class sharing, rather than in the context of individual (often diagnostic) interviews. Both written responses and class discussions were used as vehicles for focusing preservice teachers' attention on the different ways children construct their own understandings of whole number operations, the ways children use previously learned mathematics concepts to develop new concepts (e.g., addition used to develop multiplication), and the importance of developing a mathematics community in which children listen to one another in order to understand mathematics.

A fourth set of tapes (*Cookies to Share* and *Fractions on a Geoboard*, WGBH Boston, 1995) addressed framework Category 1 and accompanied a section of the course considering the development of introductory concepts related to fractions. Each of these tapes was used as an example of a "first lesson" that provided a particular interpretation of fractions using a specific manipulative model. Each situation modeled appropriate pacing of instruction and coverage of content. The course content also included hands-on work with the models being discussed.

Methodology

A variety of data were collected for this study. These included all course written work and journal writing tasks. In addition, 5 preservice teachers (4 female/1 male; all traditional age) volunteered to participate in interviews conducted as part of this study. They were interviewed and audiotaped twice during the mathematics methods course, once in late October and once in early December. They were interviewed again during their student teaching, following or near the end of teaching the mathematics units they had designed as part of the mathematics methods course.

The interview responses and selected written work of three of the preservice teachers who participated in the interview study are considered here as reports of understandings about teaching and learning mathematics developed over the course and were revisited toward the end of the student teaching experiences. The specific written assignments and interviews used as data sources are detailed in Appendix B. The three subjects were selected because of their differing stances on teaching and learning mathematics. The cases provide windows into their thinking during the course and toward the end of student teaching.

Copeland and Decker (1996) questioned the types of evidence useful in documenting the effects of using video cases in teacher education. Most research reports documenting the effects of using written cases "tend to use as evidence for efficacy an analysis of student [e.g., preservice teacher] perceptions" (p. 467). However, since it is argued that the purpose for using written cases is to address the cognitive lives of teachers, then it would make sense to look at the effects on preservice teacher cognition. Copeland and Decker suggested that preservice teachers' reports of their understandings of video cases be used to extrapolate the nature of their meaning-making. That same stance was taken here to analyze the impact of video episodes used in the mathematics methods course.

It is important to acknowledge that the mathematics methods course included more than just the use of the videos, so that attributing results exclusively to these pedagogical tools is not possible. However, the goal for the study was to explore the potential impact of videos as part of a mathematics methods course. Consequently, the analysis of data is focused on perceptions related to the impact of the video component of the course.

The analysis of the data involved identifying themes mentioned by the preservice teachers in their written and interview responses that emerged over the course of the study (Copeland & Decker, 1996). Specifically, the themes considered reflected their understandings about teachers teaching mathematics, children learning mathematics, and themselves as teachers of mathematics. The case studies highlighted the three preservice teachers' changing views over the year (i.e., during the mathematics methods course and then student teaching) as related to the themes. Discussion about the impact of the use of video episodes follows the case studies.

Case Studies

Sarah

Sarah had a traditional background in mathematics, having taken a sequence of precollege courses that included AP calculus and (college) statistics. Both algebra I and II were a struggle. "I was generally able to make Bs, but I still had little idea of what I was doing. I was still trying to memorize and follow procedures over and over."

Sarah characterized her own experiences in learning mathematics as "breezing through the St. Jude's Math-A-Thon workbook, making low grades in calculus, and struggling to stay motivated in higher level math courses." In contrast, she wanted her own students to remember that math could be both fun and

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challenging and also a part of everyday life in positive and utilitarian ways.

Early in the course, Sarah's main concerns about teaching centered around allowing students to have control over their own learning. A journal response written after viewing the video *Marshmallows* (WGBH Boston, 1995) provides insights into this frame of mind.

> I was most struck by the active role that students had in creating their own learning. I was also struck with the fact that the teacher wasn't really the teacher when that learning happened. Rather, she stepped back and gave up the "I'm going to teach you how to learn" role in favor of hoping that students would be able to do it themselves. This is quite a leap for most adults (myself included) to take comfortably with children.

Sarah appeared skeptical about the initial images of teaching as shown through WGBH Boston videos, wondering about such things as what occurred before the lesson that was viewed, whether such real-life, hands-on activities could be done without the assistance of an aide in a classroom, and whether children really stay focused on the task when working with open-ended problems.

During the first interview, Sarah spent a great deal of time discussing situations (shown in the videos) that focused on children's thinking about mathematics, either in individual interviews or in whole-class settings where children were sharing solution strategies.

> One of the videotapes we watched was kids doing...a problem...on the board, and each student would come up and show their way that they did it.... That was one thing that I definitely liked...just having kids explain and just letting kids come up until they ran out of ways to do the problem.

In response to a question about what had changed for her, Sarah talked at length about her developing awareness that children really do have different ways to solve problems. She acknowledged that before this class she would have felt that "that's a nice way to do it, but that's a really complicated way, and we need to really focus on the simplest way so that [they] can remember it." She noted that she probably would then have tried to funnel children into the traditional ways of solving problem.

At the same time, Sarah struggled with the value of letting all children explore their own strategies in solving problems. She believed that there are *some* children who need to have a known structure that can be followed every time. For these children, "math is just a process of small steps. And if you can just accomplish each of the small steps, then you'll accomplish a total problem that you thought was too big to do before." While Sarah acknowledged that providing a totally structured program might not be necessary, she thought there would be definite benefits to providing some structure along with process skills.

At the end of the course during the second interview, Sarah's attention was focused on herself as a teacher. She now saw that there is an approach to teaching math in which the teacher does not have to be the one directing the learning. She appeared to have a greater awareness that children develop mathematically and a sense of her own abilities to address their needs.

In revisiting her in the spring (Interview 3), Sarah was quite enthusiastic about the third grade geometry unit she had designed during the course and taught during her student teaching. Her awareness of children's thinking surfaced in different ways. In talking about the concepts of symmetry and congruence she had considered in her unit, she noted,

> If things are symmetrical, if a shape is symmetrical...it's an easy branch to congruence. Like one of my children looked at me and said, "Miss XXX, if I'm creating a congruent shape and they're right next to each other, they have to be symmetrical." ... I was, like, "Wow, that's really a deep thought." I hadn't really thought of that myself.

Her final comments reflected both a sense of confidence in her own ability to teach mathematics and to reflect on that teaching.

> What's interesting is ... not the fact that we watched them [videos] so much, but that we had to evaluate them....After I had done a math lesson, I was sitting down at lunch and thinking about what we had done, and I was sort of saying to myself, "Well, you know, did they get the point? Am I using enough manipulatives? Did they use the manipulatives correctly? Did I spend too much time?"...and I sort of evaluated as if I had evaluated the videos, you know? So, it was kind of helpful to have a structure for how to think about what I was doing.

Sarah found by the end of the year that she compared herself to some of the situations she saw in the videos. "I would go, 'Wow, that was a really innovative thing [for me] to do!'"

Anita

Anita's precollege background in mathematics, similar to Sarah's, did not include calculus; she took symbolic logic in college. Prior to the eighth grade, she characterized herself as a very strong student in all

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areas of school. However, when she took pre-algebra, things started to change. All of a sudden, she began to make Cs on tests. For Anita, mathematics was when "you're up at the board and then the teacher gives you time to do this problem, and...[the problems are] boring, and you're bored, and [your classmates are] bored."

However, when asked to reflect on teaching mathematics in her autobiography, she noted that a teacher must develop comfort with and knowledge about a subject to teach it well. She also thought that using different real-life situations would be one way of giving math some kind of meaning to students.

In watching the earlier classroom lessons (*Marshmallows* and *Pumpkin Seeds,* WGBH Boston, 1995), Anita was impressed by the thinking and enthusiasm the students displayed. Her main concerns centered around students working in groups and wanting to make sure all children understood and participated in the activities. She also voiced concerns about classroom management in these kinds of open-ended problem solving situations.

During the first interview, Anita continued to be impressed by the achievements of the students she saw and the problem solving encouraged by the teachers.

> We've seen in the videos how you have a problem and you say, "Okay, you guys solve it the way you want," and then showing different ways – that is an exciting way of teaching for me ... I'm definitely going to use that, because it makes sense and is more interesting to me.

During the second interview, Anita commented about her initial reactions to the directions of the course content and, again, made reference to her own experiences.

> The whole idea of having them [students] create their own understanding of it [math]...that's not how I was taught. I was taught, "This is how it's done. And you do it like the example forty times over again."... It's almost like you have to let go of how you think about it and open your mind to other ways....You're going to have to sit there and figure out how they've figured out the answer, you know, even if it's right.

Her enthusiasm grew about the prospect of teaching mathematics in ways she had never considered before. In revisiting her in the spring (Interview 3), Anita reported on the second grade geometry unit she had designed during the course and was currently teaching during her student teaching. Several of her comments focused on her ability to question children about the mathematics they were learning.

> When I was working with individual children, I didn't have much experience...[with] how to ask them questions to make sure they understand.... And those videotapes that we watched gave me a better sense. Normally, I'd be like, "Okay... good." You know? And I didn't really know how to ask the questions to figure out if they understood, and those videos really showed me, like, how you could make questions out of what they were doing. What they were doing wrong. What they were doing right. Or what they were doing period.

However, "questioning" as part of whole group instruction did not seem to fare as well. When she sought to use her questioning strategies with a larger group, her faculty supervisor noted that the children seemed to get confused. At his recommendation, she chose to use less questioning in these situations. Anita made this switch because the students seemed unclear about what she was "looking for." "It was more like they had to guess what the teacher was thinking of... so I realized that wasn't the best thing to do." She noted that she became more directive in her large group lessons.

Rachel

Rachel had a variety of experiences with mathematics. Her coursework involved (precollege) algebra I, honors algebra II, geometry, precalculus, and (college) symbolic logic. Rachel took a broader view (in her autobiography) with respect to what should happen in mathematics teaching and did not seem to tie it explicitly to reactions to her own experiences. She noted that teaching math should accomplish the same goals from kindergarten through 12th grade.

> Kids should learn basic concepts, but more importantly *how* these concepts can be applied in their world. As students progress through the grades, skills and concepts will become more complex, but should remain grounded by the ideas of meaning and application.

Rachel remained open-minded about how to teach mathematics. Her response to an early video lesson (*Marshmallows*, WGBH Boston, 1995) indicated her reflective frame of mind.

> What stands out for me ...were examples of what I saw as good teaching and learning. The teacher gave the students an interesting assignment and activity that related to what was going on in the classroom and their lives. She let the students learn actively, got parents involved by having them do their guesses at home, gave them strategies for counting, but did not dictate how they had to work.

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Her concerns early in the course focused on whether she, too, would be able to design such learning situations, get children involved and, at the same time, teach new skills.

In the first interview, Rachel, was intrigued by the interviews showing students' thinking "because it's an assessment technique." She noted that she felt she already knew a lot about how to teach in the classroom but had not worked as much on how to find out whether "what you've taught is actually getting into the kid's brain." When questioned about how she was now thinking differently about teaching mathematics, she focused on children constructing their own strategies and their own knowledge.

By the second interview, Rachel's concerns about teaching mathematics showed further growth and reflection.

> I think in my [student teaching] classroom, the kids don't talk a lot about their thinking and their strategies behind doing things ... so I think one of the hardest things will be just to move the kids from how they're thinking now about their answers to the process...I've tried to start to integrate a little bit of, "Tell me why you did that" or "What were you thinking when you used this way to get this answer?" So I've tried to, you know, sneak it in wherever I can.

In revisiting her in the spring to discuss the money unit she planned for her second grade class, Rachel commented on the importance of children explaining their strategies for solving problems. She also spent time discussing management concerns that surfaced in trying to conduct class discussions where students listened to and/or restated each other's thinking about problem solutions. She felt some frustration in not being able to keep them all focused during these discussions.

> I'm new teaching them math, and I'm trying to try all these new things and so it's just a combination of stuff that's frustrating me. And they're learning. They're doing a really good job. And my teacher keeps saying, "Rachel, they're learning. They learned money." But I think I just get caught up on the fact that they were so loud when I was trying to run this discussion.

When asked about the impact of the mathematics methods course on her teaching, Rachel indicated that having children share strategies "is something that came straight from class." In addition, her knowledge of the CGI problem types and solution strategies also were important. "I never would have known about [these] — starting out with direct modeling with Unifx™ cubes instead of going straight into, 'Okay, here's change, Let's just start working with it.'"

The three preservice teachers offered different perspectives with respect to teaching mathematics. Sarah liked to be "in charge." Focusing on giving children more control in their learning environments created a tension for her during the course. Anita's prior experiences with mathematics and her resulting concerns about taking this course soon proved groundless — somewhat to her amazement. She found that she could be successful with mathematics and came to believe that children could like mathematics. Rachel, reflective by nature, emphasized exploring student thinking and structuring ways for students to listen to each other.

Discussion

The major focus of the mathematics methods class was on preservice teachers gaining an understanding of what it means to pay attention to the development of students' mathematical thinking, both by listening to students as they solve problems and by designing lessons that promote learning based on students' making sense of new content. The course structure attempted to weave together experiences that included theoretical readings, hands-on activities, videos, and discussion. Assignments were posed in a fashion that sought to promote reflection about course purposes.

Teachers Teaching Mathematics/Selves as Teachers of Mathematics

It appears that the three preservice teachers each initially thought of teaching mathematics as didactic in nature, that is, "teaching by telling," and as essentially providing children with algorithms. While some of their comments (e.g., Sarah in her autobiography) indicated that they wanted children to like math and "have fun," their perceptions of teaching still placed the teacher at the center of learning. They appeared to have changed their perceptions, moving toward a more student-centered philosophy, and to voice a view of mathematics as something that can be developed by students themselves. In addition, they perceived that they tried to teach using new teaching strategies that promoted student development, which had been identified as important during the mathematics methods course.

There were problems as they attempted these strategies. Sarah worried whether some students needed a more didactic structure. Anita struggled with ways to question students effectively. Rachel was frustrated

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with her attempts to have her students engage in whole group discussions about problem solution strategies. However, each believed she made shifts in her views of teaching and learning mathematics *and* made efforts to teach in ways she had not anticipated at the beginning of the course. Often they attributed such changes to experiences in the mathematics methods course that involved video-based pedagogy.

Children Learning Mathematics

In the review of the three preservice teachers' responses over the year, it was observed that most of their attention appeared to be on teachers teaching and their own teaching, and not on what students were actually saying about mathematics when they talked. At this stage, preservice teachers' concerns are typically on "self as teacher" and on the details associated with management and classroom structure (e.g., Hall & Hord, 1987). It is important to note that the preservice teachers now do include within their view of classroom structure the place for students' sharing of their thinking and acknowledge that having different ways to solve problems is acceptable and desirable. Indeed, the management issues involved in facilitating a more dynamic sharing of children's mathematical thinking were reflected in both Anita's struggles with ways to ask questions and Rachel's frustrations in not being able to keep children's attention focused during a discussion.

However, most of the preservice teachers' comments appeared to focus on the fact that students need to talk about their thinking but not on what might be learned about students' mathematical understandings as they talk about mathematics. Neither did they discuss how this knowledge could be used as part of instructional decision making. As Sarah commented, one student's discussion of a possible relationship between symmetry and congruence is "a deep thought." What more might she do now that she is aware of this student's observation?

Other literature (Bright, Chambers, & Vacc, 1999) focusing on the use of CGI (Fennema et al., 1996) in preservice teacher education programs (i.e., the mathematics methods component) offers similar findings. This research involved only the CGI program and related videotapes (which were used in conjunction with other video episodes in the mathematics methods course reported here). As is the case here, the methods course instruction appeared to be insufficient to help preservice teachers understand the importance of focusing on children's thinking *for the purpose* of planning for instruction (Bright et al., 1999); rather attention seems to have been only on the thinking, per se.

It may be that the emphases in the mathematics methods course did not explicitly provoke this level of exploration about children's learning; clearly these observations will influence the design of the course in the future. It also may be that demonstrating such a level of understanding needs to grow out of teaching experience and depends both on preservice teachers' building a knowledge base of the ways children are likely to think about mathematics and about understanding, with sufficient depth, the mathematics they are teaching. Indeed, many practicing teachers find this kind of change one that takes time and emerges slowly.

Preservice Teachers' Perceptions of Use of the Videos

From the preservice teachers' perspectives, the video episodes provided a common point for reflection. They also provided an alternative way to address the need for access to classrooms with established mathematics communities that support children developing their own mathematics knowledge (Rachel, indeed, commented on this). Further, the video episodes made it possible to encounter examples of the topics and issues that were being addressed in the course (i.e., helped the instructor "get across what she's trying to teach us to do"). Finally, as Rachel noted, "They really did give me an idea of what a productive math class looks like and how to give kids broad problems that they can go out and solve on their own."

Conclusion

This study raises methodological concerns. Qualitative by design, the data sources were preservice students' work from the course and interviews conducted by an outside interviewer. The course instructor did not have access to interview data until the course was completed and grades were determined, in order to protect students' rights — a human subjects concern when studying one's own teaching while engaged in that teaching. Preservice teachers were interviewed once they began student teaching but were not observed for purposes of documenting interactive behaviors with children. While the focus of this analysis and the interview questions addressed the video component of the course, it is probable that the other components of the course may be shown also to have substantial impact. Indeed, one would hope they did, since they constituted a substantial part of the course work, as well.

Despite these limitations, it appears there is potential for video-based pedagogy to provide

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alternative experiences that may stimulate reflection and reconstruction of beliefs on the part of the preservice teachers, moving from a didactic to a more student-centered pedagogy. The use of video-based pedagogy in the context described provides opportunities to connect preservice teachers' university course work more explicitly with actual classroom practices and provides some unique opportunities to consider ways to interact with and study students.

References

Bright, G. W., Chambers, D. L., & Vacc, N. N. (Eds.). (1999). *Incorporating cognitively guided instruction into elementary preservice teacher education programs: Results from a National Science Foundation research project.* Madison, WI: University of Wisconsin, Wisconsin Center for Education Research.

Copeland, W. D. (1989). Technology-mediated laboratory experiences and the development of clinical reasoning in novice teachers. *Journal of Teacher Education, 40*(4), 10-18.

Copeland, W. D., & Decker, D. L. (1996). Video cases and the development of meaning making in preservice teachers. *Teaching and Teacher Education, 12*(5), 467-481.

Fennema, E., Carpenter, T. P., Levi, L., Franke, M. L., & Empson, S. (1996). *Cognitively guided instruction.* Madison, WI: Wisconsin Center for Educational Research, School of Education, University of Wisconsin. Unpublished manual and video tapes.

Goldman, E., & Barron, L. (1990). Using hypermedia to improve the preparation of elementary teachers. *Journal of Teacher Education, 41*(1), 21-31.

Hall, G. E., & Hord, S. M. (1987). *Change in schools: Facilitating the process.* Albany, NY: State University Press of New York.

Harrington, H. L. (1995). Fostering reasoned decisions: Case-based pedagogy and the professional development of teachers. *Teaching and Teacher Education, 11*(3), 203-214.

Kagan, D. M. (1992). Professional growth among preservice and beginning teachers. *Review of Educational Research, 62*, 129-169.

Kamii, C. (1990). *Multiplication of two-digit numbers: Two teachers using Piaget's theory* [Video]. (Available from Teachers College, Columbia University, New York 10027).

Lappan, G., Fey, J., Fitzgerald, W. M., Friel, S. N., & Phillips, E. D. (1998). *Connected mathematics program.* Palo Alto, CA: Dale Seymour Publications.

Merseth, K. K. (1996). Cases and case methods in teacher education. In J. Sikula, T. J. Buttery, & E. Guyton (Eds.). *Handbook of research on teacher education* (pp. 722-744). New York: Macmillan.

McIntyre, D. J., Byrd, D. M., & Foxx, S. M. (1996). Field and laboratory experiences. In J. Sikula, T. J. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education,* (pp. 171-193). New York: Macmillan.

National Council of Teachers of Mathematics (1989). *The curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics.* Reston, VA: Author.

Richardson, K. (1990). *A look at children's thinking* [Video I & II]. (Available from Education Enrichment, Inc., P. O. Box 1524, Norman, OK 73070).

TERC (1998a). *Numbers and operations: Building a system of tens* [Video]. (Available from Dale Seymour Publications, 10 Bank Street, White Plains, NY 10602).

TERC (1998b). *Numbers and operations: Making meaning of operations* [Video]. (Available from Dale Seymour Publications, 10 Bank Street, White Plains, NY 10602).

WBGH Boston (1995). *Teaching math: A video library, K-4.* South Burlington, VT: The Annenberg/CPB Math and Science Collection, P. O. Box 2345 (800-765-7373)

Wood, T., Cobb, P., Yackel, E., & Dillon, D. (Eds.). (1993). *Rethinking elementary school mathematics: Insights and issues.* Reston, VA: National Council of Teachers of Mathematics.

Van De Walle, J. A. (1994). *Elementary school mathematics* (2nd ed.). White Plains, NY: Longman Publishing.

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Appendix A

Reform-based Lesson Plan

(Adapted from the *Connected Mathematics Program*, Lappan, Fey, Friel, Fitzgerald, & Phillips, 1998)

Mathematical Goals

What are the mathematical ideas of the lesson?
What do I want students to know when the lesson is finished?
What mathematical vocabulary does this lesson bring out?
What difficulties can I foresee? What misunderstandings might arise?

Materials/Classroom Setup and Organization

How will I organize the students to do this lesson? (individual, pair, group)
What materials will students need? How will I set up access to materials?
If the lesson takes more than one day, how will I arrange for smooth transitions across days in terms of classroom logistics?

Instructional Model

LAUNCH
- How will I launch this lesson?
- What prior knowledge do my students need?
- How can I keep from giving away too much of the solution strategy?
- How can I make it personal to them?

EXPLORE
- What are different strategies I anticipate students using?
- What kinds of questions can I ask:
  - To prompt their thinking?
  - To make them probe further into the lesson if the initial question is "answered"?
  - To encourage student-to-student conversation, thinking, learning, etc.?

SUMMARIZE
- How can I orchestrate the discussion so students summarize the thinking in the lesson?
- What mathematics content and processes need to be drawn out and/or emphasized?
- What ideas do not need closure at this time?
- How can we go beyond or what do we need to generalize?
- What new questions might arise?
- What will I do to follow-up, practice, or apply the ideas after the summary?

Reflections

What level of sophistication do I expect my students to achieve in working through the lesson?
How will I assess their understanding using their interactions and responses?
What ideas do I want to emphasize?
What writing assignment (if any) will I use. How can I structure it?

Timing

How long will this lesson take?
What can I do to assure the time spent in class matches the "size" and the goals of the lesson?

Assessment Goals/Strategies

What kinds of assessment tasks (if any) do I want to develop that will help my students better understand the mathematics?

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Appendix B
Data Sources

Autobiography (August 1996) – Preservice teachers wrote their mathematics autobiographies; as part of this task, they commented on how they currently viewed teaching mathematics.

Journal responses (September 1996) – Preservice teachers viewed two different WGBH Boston (1995) video episodes (*Marshmallows* and *Pumpkin Seeds*) and designed team lesson plans that each described the development of a problem-centered mathematical investigation. The journal prompts following each of these tasks were as follows: What stands out for you after viewing this video? What concerns (if any) about teaching/learning mathematics does this instructional situation raise for you?

Interview 1 (late October 1996). Additional videos viewed included Fennema, et al., 1996; Richardson, 1990; Kamii, 1990, and TERC, 1998a, 1998b. The emphasis was on children's thinking individually (diagnostic interviews) and in whole class sharing of solution strategies. Interview questions included discussing the effects of video episodes, the professor's reasons for use of video episodes, and how the videos affected their views teaching of mathematics.

Interview 2 (early December 1996). Additional videos viewed included two WGBH Boston (1995) videos, *Cookies to Share* and *Fractions With Geoboards*. Interview questions included discussing the challenges of teaching mathematics, what questions they still had about teaching mathematics, ways they would redesign the mathematics methods course, and how they were thinking differently about teaching mathematics.

Interview 3 (late April 1997) Preservice teachers were interviewed about the implementation of curriculum units they had designed as an assignment in the mathematics methods course and taught during their student teaching. Interview questions addressed reports of their experiences implementing their units, their knowledge of children's understandings of the content of their units, and their reflections on teaching mathematics and the use of videos.

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