Creating Effective Video To Promote Student-Centered Teaching

By Julie Gainsburg

Training and investing teachers at all career levels in student-centered practices is widely recognized as a significant challenge (Anderson, 1989; Spillane & Zeuli, 1999). Teacher resistance to educational reform has been well documented for decades (Cohen, 1989, 1990; Cuban, 1988), and mathematics teaching seems particularly impervious. Various studies document the failure of student-centered teaching practices to take hold in K-12 mathematics classrooms in significant ways, including collaborative work, (Jacobs, Hiebert, Givvin, Hollingsworth, Garnier, & Wearne, 2006); problems that are cognitively demanding or that encourage connections (Jacobs, et al., 2006; Stein, Smith, Henningsen, & Silver, 1999), inquiry-based approaches (Weiss, Pasley, Smith, Banilower, & Heck, 2003); teacher questioning to enhance student understanding (Spillane & Zeuli, 1999; Weiss, et al., 2003); classroom-based performance assessments (Borko, Mayfield, Marion, Flexer, & Cumbo, 1997); and student choice (Jacobs, et al., 2006). While pre-service math-teacher education is not solely to blame for this failure, it is also the case that pre-service training has been relatively unsuccessful at promoting nontraditional teaching practices in new mathematics teachers, in spite of the efforts and intentions of university-based teacher educators.

Julie Gainsburg is an assistant professor in the Department of Secondary Education in the Michael D. Eisner College of Education at California State University, Northridge.

Overcoming resistance to student-centered methods has been my major challenge in teaching the secondary-level mathematics-methods course in my institution's credential program. Researchers have identified several phenomena that work against the acceptance of student-centered teaching practices, but two have particular relevance for my pre-service teachers (PSTs).[1] First, because most teachers (and administrators) experienced mostly or exclusively traditional schooling as students, they are unfamiliar with, and have little faith in, nontraditional methods (Ball & Cohen, 1999; Smith, 1996). Second, even when educators stand behind student-centered methods in general, many believe such methods are inappropriate for particular groups of students (Spillane, 2001), such as English-language learners (ELLs), students who lack basic mathematical skills, students of poverty, and students from non-mainstream home cultures. I see both phenomena operating in my methods class: PSTs often do not clearly understand what student-centered practices are, and many do not believe such practices are possible or effective with the kinds of students they expect to teach. (New teachers in our local districts are typically assigned classes with weak mathematics skills and high concentrations of ELLs and low-SES students. This aligns with a general trend in class assignments for beginning teachers [Johnson & The Project on the Next Generation of Teachers, 2006].)

An often-recommended strategy for promoting student-centered methods in pre-service courses is to show video of exemplary K-12 classrooms (Knight, Pedersen, & Peters, 2004; Office of Technology Assessment, 1995; Richardson & Roosevelt, 2004; Weiss, et al., 2003). Ideally, classroom video can illustrate how theories about teaching can be implemented in practice (Sherin, 2003), provide teachers with a shared, concrete experience for discussion and reflection (Ball & Cohen, 1999; Copeland & Decker, 1996; Stigler, Gallimore, & Hiebert, 2000), and encourage teachers to adopt a practice by showing a real teacher implementing it successfully (Hatfield & Bitter, 2004; Pailliotet, 1995). Several professionally produced video projects for teachers have aimed to capitalize on these potential benefits and are available for purchase or free on the Web (e.g., Case Technologies to Enhance Literacy Learning [CTELL], n.d.; Technology in Literacy Education [TILE], n.d.).

I have used professionally produced video of secondary mathematics classrooms in my teacher-education classes, but I have found them disappointingly ineffective (all the more disappointing because of my own past involvement in professional classroom-video production projects!). This is not to completely dismiss professionally produced video, whose effectiveness I have witnessed in certain settings, particularly optional professional development sessions for teachers who come with a desire to move away from traditional teaching methods and need the concrete information a video can provide about how to do so. But many pre-service and new teachers (and even veterans) are wary of nontraditional methods. Further, they can be defensive about being told how to teach by professionals (including video producers and education professors) who are not "in the trenches" (an attitude also observed by Toll, Nierstheimer, Lenski, and Kolloff [2004]).

I sympathize to some degree with these sentiments; they seem a natural reaction to the uncertainty experienced by new teachers and their overriding need to feel in control. Student-centered methods shift some authority to students—a scary and threatening proposition for any teacher (Anderson, 1989; Cohen, 1989; Smith, 1996). Many PSTs also feel that the methods I promote in my course run counter to the teacher- and content-centered methods encouraged by administrators and mentors in the schools, especially when school-based professional development aims at elevating students' standardized test scores (Randi & Zeichner, 2004). Given the documented failure of reform to take significant hold in classrooms, PSTs may see few local teachers modeling student-centered practices.

In short, PSTs enter my methods course far from sold on the idea of student-centered teaching, and, perhaps surprisingly, professional video does not "sell" it well. Over the years, I have found that professional video gives those PSTs who are predisposed to resist nontraditional methods ample excuses to dismiss the video's content. Particular qualities of professional video appear responsible for their dismissal, conscious or not. Professional video often presents the featured teachers as exemplary, award winners, or stars. The unintended message: A new or even plain old teacher can't pull this off. (This intimidation effect has also been noted by Stigler, et al. [2000].) Professional video is, of course, professionally edited. It typically shows only the parts of the lesson that ran smoothly and the students who responded appropriately. Some videos are obviously partly staged and include fake "B-roll" clips of smiling, nodding students that may even have been shot at a later time. Stiff teacher interviews and voiced-over narration further signal the exceptionality of the taped class. The message: The lesson wasn't really this good, the "warts" were removed, and this teaching method is not as effective as implicitly claimed. Finally, professional video often depicts classrooms with demographics unlike local ones. The message: This teaching method only works with "other" kinds of students (fill in as appropriate: wealthy, White, native-English-speaking, honors) or in "other" kinds of settings (small classrooms, districts without strict testing and curricular mandates). It won't work with my kids.

California State University, Northridge, is one of the state's largest producers of secondary teachers, and most graduates go on to teach locally in the Los Angeles Unified School District (LAUSD) or neighboring districts. Once for each of the past three years, I have taught our one-semester secondary-mathematics methods course, each time to a diverse group that includes recent B.A. earners and midlife career changers with a range of teaching experience. In the first two years, I used professional video in this and other courses, and I found its power greatly compromised by the attitudes I have just described. Some PSTs entered these courses resistant to the methods I was promoting, and they completed the courses nearly as resistant, the video having done nothing to change their minds. PST comments on the final (anonymous) course evaluations for those two years give the flavor of this resistance:

> [The methods presented in the course are] still artificial, because in real teaching students sometimes will not listen, cooperate. *(Teacher with some experience)*
>
> I felt that [the methods] class focused on groupwork, and as interesting as I find it I don't feel that it is what I need to know to start teaching. *(PST with no teaching experience)*
>
> I find [course readings and assignments] lacking in actual hands-on methods for dealing with the array of obstacles in a classroom that may roadblock such ideas. They are good ideas but not necessarily applicable in my classroom. *(Teacher with some experience)*
>
> We saw/did groupwork, is this realistic? In an ideal world, yes, but not in our schools today. *(Teacher with some experience)*

Certainly not all PSTs feel defensive or resistant to the ideas in my course, but when even one or two express these sentiments (usually loudly), it has a chilling effect and dampens the eagerness of the class to explore new methods.

In the remainder of this article, I describe a project to produce a video library for my methods and other teacher-education classes that was designed to retain the many benefits of professional classroom video but overcome its shortcomings. I also share the results of its use in my most recent methods course (2006). Although my project focused on mathematics teaching, I believe the problems I found with professional video, the resistance of my PSTs to nontraditional methods, and the efficacy of the features and use of the video I produced are directly relevant to the teaching of any subject. Most importantly, this low-budget project required few technical skills and could be easily replicated by any teacher educator.

The Video Project

Goals

In the fall of 2005, I received a grant from my university of a one-course teaching release and a small amount of funding for supplies, to produce a set of videotapes. (I had access to a department digital video camera.) My overarching purpose was to produce video segments that supported the goals of my methods course: to develop mathematics teachers who implement student-centered teaching practices (as recommended by the National Council of Teachers of Mathematics [NCTM, 2000]) and who elicit and attend to student understanding to plan effective, responsive instruction (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Philipp, Thanheiser, & Clement, 2002); and to develop in these teachers the habits and skills of critical reflection on their own and others' teaching practice (Ball & Cohen, 1999).

Sherin and van Es (2005) report the success of video-based professional development to improve teachers' ability to notice and interpret classroom interactions, and my goals largely paralleled theirs. But because they worked with in-service teachers, Sherin and van Es could videotape the participating teachers' own class-

rooms, which afforded the ultimate level of freshness, local-ness, openness, and credibility. My challenge was to create video with these qualities, despite being shot in "someone else's" classroom in a process invisible to my PSTs.

Teacher Selection and Solicitation

I began with a fairly clear idea of the teaching practices and learning situations I wanted to capture in the segments—ones already central to my methods course: discovery learning; collaborative work; inquiry-based, whole-class discussions; tasks with a high level of cognitive demand; and performance assessment projects. Given the difficulties of arranging to shoot video in schools, however, I predicted it would be easier to guarantee useful video by targeting teachers known to employ student-centered practices regularly, rather than searching for a teacher who planned to implement a specific teaching method on a particular day. Thus, I could schedule the taping dates as much for logistical reasons as lesson content. I located these teachers in various ways: Some I had taught or supervised at the credential or masters level, one had mentored a student teacher I had supervised, one I had encountered during a research study, and one was recommended by a colleague—the only teacher I had never met prior. Most of the classrooms were in LAUSD; all were racially diverse, with a majority of the students being Latino, and with many ELLs. I chose almost all lower-level courses (pre-algebra, algebra, and geometry) because my PSTs would teach mostly these in their first few years. Also, in the minds of PSTs and many school administrators, these courses, especially first-year algebra, are the most difficult in which to employ student-centered methods; yet, to my mind, student-centered teaching is the most critical here. In the end, my decision to target the most student-centered teachers I could find and worry less about catching "just the right day" paid off. Every taped lesson yielded at least 15 minutes of footage that was sure to generate rich discussion.

Taping

Once in the classroom, before taping, I introduced myself to the students and explained that I taught new teachers and wanted to show them the kinds of good things I knew went on in this class.[2] I displayed the small camera and demonstrated how close I would get to the students during groupwork. I promised that if I held the camera on their group for a long time it was because I heard a great discussion going on there. I did not bother giving instructions about how to behave, because I knew I would use only a portion of the tape. If a student mugged for the camera, as occasionally happened, I just moved to a new group.

While shooting, I made no attempt to change the lesson's course. I hand-held the camera and moved around the room to get closer to the students who were talking. Once students began group or pair work, I moved towards a group that I heard discussing mathematics in loud voices.[3] I stayed with a group as long as the conversation was interesting; if the students showed signs of discomfort with the

camera, I moved to another group. I typically did not follow the teacher; usually my most interesting footage was of groups working independently. (This was of special interest to the teacher, who, afterwards, could see in the video how groups worked in her absence.) I also shot students' written work or actions with hands-on materials when it was relevant to their discussion. Even if it resulted in shaky, blurry, or upside-down images not used in the final segment, it documented the problem the students were working on and the steps they attempted—valuable information to provide verbally or on a handout for viewers of the video.

Afterward, I gave a copy of the entire tape to the teacher and offered to debrief the lesson with her after she had viewed it, as a "critical friend." A few took me up on this offer.

Editing

From each lesson, I edited about a 15-minute segment, comprising about five clips of video that usually included some teacher introduction of the activity and one or two groups at work. I tried to select clips that would show the power of collaborative work and discovery activities to engender productive conversations and to unearth misconceptions, as well as to provide my PSTs with "real" students for whom they could consider further teaching interventions. I used the basic video-editing program included with my laptop, then burned the segments onto DVDs. I also developed a binder of accompanying materials: background information about each lesson, copies of handouts the teacher had used, summaries of the video segments with times, and discussion questions to use with PSTs.

The resulting video segments look quite unlike professional video. First, they are obviously shot by an amateur (and if the shaky, wandering images leave any doubt, I announce to my class that I did the shooting), with a single camera and no visible microphones or wires on the teacher or desktops. There are no titles, special effects, or "B-roll," just a few straight cuts. Students making mistakes or expressing confusion are seen along with successful students (although I generally left out episodes where students were off task, because the focus of my course is mathematical learning, not classroom management). Also, because I had personally been in the classrooms during the lessons, spent much time reviewing the video while editing and writing materials, and spoken with the teachers at least about the taped lessons (with most of the teachers, we had spoken about their teaching on many occasions), I knew the segments and the teachers far more intimately that I would with commercial video. As a result, I could supplement the video with "inside" information about the lesson, teacher, or school context.

Using the Tapes in Class

Having these new video segments did not significantly change my methods syllabus for 2006. I maintained the same areas of emphasis: teaching for understanding, assessment for understanding, and productive environments for learning.

But now, for each subtopic, I used a video segment (if I had one) that illustrated a theoretical approach (e.g., *complex instruction* [Cohen, 1994]) or had the potential to drive rich discussion about a practice or learning theory. In the 15-session course, we viewed and discussed nine video segments, of which seven were produced for this project. Video viewing was always embedded in an activity with a specific viewing task to analyze teacher and/or student actions. (Typically, a video-viewing activity would take an hour of our 3.5-hour session and involve about ten minutes of video.) I always invited my PSTs to praise and critique the video lesson, and during these discussions I fought the temptation to defend the student-centered practices against criticism.

Most importantly, when introducing the segment, I presented the teacher not as exemplary but as a local colleague engaged in everyday practice. (I never explained how I selected the teachers, and no PST ever asked.) The message I hoped PSTs would take from this framing was: This is what's done by normal teachers in our district, with our particular constraints and policies, with kids who look like the ones I'll teach. This "street credibility" was enhanced when, on occasion, a PST recognized the teacher in the video. Framing the videos this way seemed to prevent the defensiveness that would have arisen had the PSTs perceived that I was showing them "the right way to teach." Instead, we took the stance that all teaching can be improved and that teachers must reflect on the strengths and weaknesses of any lesson in order to grow and better serve their students. As Sherin and van Es (2005) recommend when viewing video with teachers, I encouraged the PSTs to *investigate* rather than *evaluate* the teaching they saw. In the end, there was no need for me to have pronounced the teachers in the videos "good." Although the PSTs always found room for improvement in the lessons, their comments revealed that they recognized these as effective teachers and practices worth emulating.

Much of the footage I showed depicted the students, not the teacher (in part because in student-centered teaching, teacher presentation constitutes a small portion of the lesson), and my viewing prompts focused the PSTs' attention on the students' thinking. My aim was to train the PSTs to place students at the center of their lesson planning; to realize the necessity of ongoing, informal assessment; and to recognize the pervasiveness of student misconceptions and the importance of uncovering and addressing them. Because many of our PSTs do not yet work in classrooms, the video provided the opportunity to see the effects of certain practices on real students and to consider next steps; otherwise the lesson planning done in methods class is hypothetical, planned in a vacuum for no one in particular.

Here I give an example of how I used one video segment in my methods class. During the unit about teaching algebra for understanding, the subtopic for the class session was student misconceptions. I introduced this topic with a brief explanation of the importance of finding out and addressing misconceptions. Echoing the assigned reading for the session, I asserted that students do not come to class as blank slates; rather, they bring strong preconceptions about mathematics and must

merge new concepts with those preconceptions—must understand new concepts in the context of their prior understandings. Thus, teaching mathematics is as much about extending or changing prior notions as about presenting new material.

During the previous session, we had viewed the first part of a video of Sam's[4] ninth-grade algebra I class, in which Sam introduced the day's activity. Students in small groups were given a few styrofoam coffee cups and a ruler; their task was to determine how many cups would form a nested stack that reached the ceiling. Sam's worksheet (which I copied for the PSTs) guided the groups to find the height of a stack of two cups, three cups, four, etc., plot these data on a graph, and ultimately write an equation. For this methods-class session, I showed a later part of the lesson, when two groups struggled with the cup task. I gave my PSTs the viewing prompt: "As you watch, try to determine where the students are getting stuck and what, if any, misconceptions they seem to have."

In the video, one group of students argues about the height of a 30-cup stack. They have measured a 15-cup stack at 33.5 cm. Now, one group member asserts (incorrectly, because the cups nest), that for 30 cups they should add 33.5 and 33.5, while another member insists that idea "wouldn't work." Later in the segment, this group and another wrestle with a new problem: their measurements of the variously sized stacks do not strictly adhere to a linear pattern—each additional cup does not add the same increment of height to the stack. Both groups debate whether to graph the linear pattern or the measurement data. Although they do not articulate it this way, their question essentially is whether the measurement data are a poor approximation of a "true" pattern, or the pattern a poor approximation of "true" measurement data. This dilemma was anticipated neither by Sam nor, apparently, by the developers of the cup activity, yet it seems a critical issue for students to grapple with when learning to model real-world phenomena.

After viewing this video, I asked PSTs to volunteer to describe what they saw the groups struggling with. I structured the rest of the discussion around these questions: Why do you think students develop these misconceptions? What might have happened in their past learning to explain these? How effective is the cup activity in revealing these misconceptions? In helping students correct these misconceptions? If you were Sam, what might you do in class tomorrow to help students continue to develop this concept and clear up their misconceptions?

I used other video segments differently. In one segment, pairs of students created a children's book about quadrilaterals. When our class addressed assessment, I had small groups of PSTs draft a rubric for assessing the children's-book project based on what they had seen in the video. Then they examined a few (anonymous) student work samples I had copied, tried to score them using their drafted rubric, and revised their rubric based on this experience.

Another segment brought a particular manipulative—algebra tiles—to life. I introduced the PSTs to the tiles through an exercise involving polynomial operations with the tiles that algebra students might do. Then I showed a video of a

local teacher demonstrating the use of the tiles for solving equations and a group of her students attempting to practice it. My PSTs discussed the advantages and disadvantages of the tiles for this particular group and considered ways to leverage the tiles' power (and avoid algebraic confusion) in classrooms in general.

When our topic turned to promoting students' mathematical autonomy (Greenwood, 1993), I invited one of the taped teachers, Lora, to my class. Lora explained the collaborative method of *complex instruction* and how she supported it in her classes. Then we viewed video of her algebra class, in which three group members took responsibility for the fourth, who had not kept up with the activity and caused the group to fail Lora's on-the-fly "group quiz." Afterwards, my PSTs enjoyed the opportunity to ask Lora questions ranging from theoretical to practical.

To prepare my PSTs for their first "microteaching" assignment—they have four minutes to introduce and set up a classroom activity—I had them contrast two video clips in which the teachers introduced activities differently. It was unnecessary for me to tell my PSTs what made for an effective introduction; they could easily isolate several elements from the clips.

Regardless of the topic illustrated by the video, I always tried to emulate a constructivist theme common to exemplary professional development projects, in which, as Randi and Zeichner (2004) describe it, teachers are positioned as "active learners, discovering and activating new knowledge about teaching and learning," by inquiring "into the subject matter they [teach], into the nature of student learning, and into their own teaching practice" (p. 201).

Findings

From my perspective as the course instructor, these video segments were invaluable and made the 2006 iteration of the methods course the smoothest and clearest of the three times I have taught it. Major course concepts, such as the importance of listening to students and monitoring their understanding, student autonomy, cognitively high-level tasks, and the benefits of collaborative work, were far easier to convey with concrete examples. The video allowed me to teach in a constructivist manner (consistent with the way I urge my PSTs to teach), in that it allowed the PSTs to build their own understanding of each concept through the analysis of real classrooms rather than having to accept my definitions. Overall, I believe the video offered this year's PSTs the advantages of professional video but overcame its shortcomings.

Assessing what my PSTs learned as a result of this video is, of course, harder than assessing how easy it made my job of teaching the course. Small enrollment numbers in the course (around 20 each year) make it difficult to distinguish the impact of the video from personal characteristics of the PSTs in each class. Below, I draw on three data sources to suggest the video had the desired impact. These are: 1) class records (formal and informal) of grades, attendance, and participation, 2) a video-analysis assessment, and 3) PST self-reports.

Class Records

A main purpose for the video was to combat resistance to the student-centered teaching methods promoted in the course. Indeed, this year's class was the first to mount virtually no resistance, but I cannot be sure that the cause was the video rather than the chemistry of the class or background of individual PSTs. Similarly, this year's class earned the highest course grades (an improvement of about 6% and 5%, respectively, over each of the prior two years), and grades in this course largely reflect a grasp of the main concepts. This year's PSTs were more engaged in discussions and class activities and attended more class sessions (an average of .65 missed sessions per PST this year versus .75 and 1.09 in the prior years, respectively). When crafting feedback about classmates' presentations, this year's PSTs included more comments about the cognitive level of the mathematical tasks in the presented lessons. Finally, this year's course and my teaching received the highest student-evaluation scores of the three years (an improvement of 11% and 6% over the prior years, respectively). Of course, I do not know what portion of these positive outcomes to attribute to the video versus other aspects of the course. However, most other aspects of course remained unchanged from prior years. As well, the video was so integral to class activities that identifying its isolated impact would be, in some sense, meaningless.

Video-Analysis Assessment

A more direct measure of the PSTs' growth was afforded by the following assessment. On the first night of the 2006 course, the PSTs viewed a video clip produced by the Third International Mathematics and Science Study (TIMSS) (Lesson Lab, 2003) depicting a "typical" U.S. 8th-grade mathematics class. The PSTs described in writing what stood out for them in the video and what seemed educationally effective and ineffective. On the last night of the class, without having warned the PSTs, I repeated the exercise, having the PSTs review the same video and write to the same prompts. I then handed back their first-night responses and asked them to compare the two. Table 1 shows my analysis of the PSTs' responses, pre-course (first night) and post-course (last night). The table lists the features the PSTs explicitly noted as effective and ineffective, with numbers of PSTs mentioning each.

These results reveal a marked change over the semester in what the PSTs looked for and valued when analyzing teaching, with a distinct shift towards student-centered practices. Many PSTs had initially praised the teacher in the video for her lesson sequencing: a clear explanation and demonstration by the teacher followed by student practice. At the end of the course, fewer PSTs cited this as effective. Similarly, many PSTs had initially felt the teacher should have provided more explanation of the concepts, but no PST felt this way at the end of the course. Relatedly, pre-course, more PSTs were uncomfortable with the prospect of student confusion. Post-course, many objected to the authoritative style of the teacher, perceiving that she dominated the lesson with her own talk; the PSTs now wanted

more opportunity for student discovery and hands-on learning. Although students in the video were seated in groups, the posed task was not truly collaborative, a fact noted by only one PST pre-course but by six PSTs post-course. Post-course, the PSTs were also more aware and critical of the cursory treatment the teacher gave each concept. My PSTs had obviously shifted their notion of effective teaching, initially understanding it to be providing clear explanations and procedures, now seeing it as challenging students to discover ideas for themselves. Further, at the end of the course, the PSTs were disturbed by the manner in which the videotaped teacher handled student questions and responses. Ten PSTs commented, post-course, that the teacher dismissed student questions or did not do enough to invite them in the first place; only four PSTs had mentioned this pre-course. Apparently, my PSTs had come to see that an effective lesson was not a script that could be entirely preplanned. They now believed that the effective teacher constantly listens to her students and allows their understandings and misconceptions to influence the course of instruction. Table 2 gives a sample of the PSTs' written responses for this assessment. Again, while gains are evident in the results of this assessment, it is impossible to ascertain the degree to which my new video segments contributed to these gains, relative to other course aspects.

Table 1
Analysis of Pre- and Post-Course TIMSS Video Responses for 2006: Most Significant Changes

	Pre-Course[a]	Post-Course
Cited as effective features		
Teacher uses multiple representation forms and manipulatives	14	8
Sequence (demo-practice)	7	3
Groupwork or group seating	5	9
Cited as ineffective features		
Too little student discovery or no student use of manipulatives	0	10
Teacher authoritative or dominated talk	1	11
Teacher doesn't encourage or respond appropriately to student questions	4	10
Teacher explains too little	6	0
Too little group interaction	1	6
Too many topics or cursory topic treatment	2	6
Students appear lost	5	1

[a] Sixteen of the 17 PSTs enrolled in the 2006 course participated in both the pre- and post-course activity; only these 16 PSTs' responses are included here.

Table 2
Typical PST Pre- and Post-Course (2006) Comments Regarding the TIMSS Video

PST	Pre-course	Post-course
Female; no teaching experience	"The teacher asked about what the graph would look like, but didn't really give a good example. I would have graphed a bit more examples or in detail."	"She is giving the kids all the needed info and not really allowing them to discover it. Teacher seems to have the mind set that only her way is the right way."
Female; 1 yr. high school and 3 years elementary experience	"I think the teacher could have had a better outcome with the manipulatives with a little more explanation and also showing how another number like 3 would 'grow.'"	"The teacher was doing all of the work. . . . She talked very quickly and covered a lot of information that the students were supposed to passively digest."
Female; no teaching experience	"I liked the way the teacher explained the exponents. . . . I am not totally sure but maybe she should have asked if they have any questions."	"The teacher just lectured. She asked questions but didn't wait for the answer. She answered the question for them. . . . It seemed as if she was talking to Kindergarteners."
Female; no teaching experience	"It might have been better if she had taken an additional step before the students started working individually and 'expanded' some variable exponents."	"She really told them step by step what to do, even in the part that was somewhat discovery-like. 'Expand that out.' Kids didn't get to figure out what to do."
Male; no teaching experience	"Showed why the 'rules' work instead of just shortcutting to them."	"Teacher does all of the talking and leaves little to the students' exploration. She is on a schedule and does not stray from her agenda."

PST Self-Reports

The most direct evidence I have of the videos' contribution are the PSTs' comments. At midterm, after viewing and discussing five of the seven segments they would view during the course, my PSTs wrote in response to the following prompts:

(1) How has viewing the video, along with the related activities, impacted your learning in this course?

(2) Please comment on how any particular videos have impacted your learning.

(3) Please comment on how any particular videos have influenced your work products for this course, your actual teaching practice, or how you think about teaching.

Responses were overwhelmingly positive. Following are typical excerpts from five PSTs:

> I have found the videos to be helpful in better understanding mathematical misconceptions. It also helps to see more of why the kids are thinking the way they are thinking. I also have a better concept of what really keeps the children's attention and what has them fading away. The more they get to discover on their own the more they stay in tuned. *(Female, no teaching experience)*

> I think that the videos gave us a realistic look at how things do and do not work in the classroom. Many times, what we think will be simply understood is actually complicated for the students. *(Female, 3 years elementary and 1 year high school teaching)*

> It has changed my approach in teaching my own students, as I am more conscientious of their thought process, and ways I present the material. *(Male, 6 years middle school teaching)*

> Before the video, I looked for ways to make students understand the concepts and make it 'click' in their heads, but now I find myself striving to prevent students' misconceptions also. . . . Every time we watched the video, I reflected on my own teaching techniques and learned what to do and what not to do. *(Female, 5 years elementary and 1 year middle school teaching)*

> It's good to see the students doing the work. No sense in the teacher doing all of the work considering she's the one who already knows how to do math. Get the students working. The more they work, the more they learn. *(Male, no teaching experience)*

Next Steps

When I began this project, I envisioned a relatively permanent library of video segments that would become part of my course materials for years. Now, although I have used the video only one year, I realize the value in continually producing new segments and keeping the library "fresh." First, the impression that I want to give PSTs—that these practices are the local norm—is better accomplished when I can honestly claim to have shot the video "the other day," as if such classrooms were ubiquitous and such lessons commonplace. Second, my ability to structure activities and discussions around the video is enhanced when the "live" lesson and conversations with the teacher are fresh in my mind. Third, I hope to establish a custom among local mathematics teachers of being videotaped for the purpose of teacher education. Taping a classroom for use in teacher training can have many benefits for the featured teacher and students: it validates and honors the teacher's

student-centered practices (which, lately, can seem under attack), particularly in the eyes of the teacher's site administrators; it affords a powerful means of self-reflection for the teacher; and it signals to her students that adults (beyond the teacher) value their engagement in serious mathematical thinking and activity. The more local teachers I can draw into this project, the wider the benefits will spread, advantaging not only the videotaped teachers and students but also PSTs who may eventually apprentice in their classrooms. I hope to convince my PSTs of the value of videotaping themselves regularly for the purpose of self-reflection, when they have their own classrooms. In fact, in response to recent state legislation, most California teacher-credentialing programs, including ours, now require PSTs to complete a capstone performance assessment that includes their analysis of video of their teaching. Moreover, I hope to set the expectation that I might one day ask former PSTs who teach locally to "donate" their student-centered classrooms to the cause and be videotaped for the next generation of PSTs. An added benefit would be the compilation of a longitudinal (video) data set that might document developments in instructional over the years.

I end with two recommendations for other teacher educators. First, leverage the power of exemplary local practitioners, if not by video then by inviting them into the university classroom. The more we build a community of student-centered teachers and showcase their work, the more we support and encourage such practices in new and veteran teachers. Second, even when "showcasing" exemplary practice, invite PSTs to evaluate and critique it. This prevents the defensiveness that arises from being shown *the* way to teach, and it demonstrates for PSTs that reflection and self-improvement continue at all levels of teaching experience and proficiency.

Notes

[1] "Pre-service teacher" is a misnomer for about half my methods students, who come with one or more years of teaching experience. Some teach in private schools, some are elementary teachers seeking an additional, secondary-level credential, and many are teaching on "emergency permits." Nevertheless, I use "PST" to refer to students in my methods class, regardless of experience, for brevity and to reserve "student" for secondary-level mathematics students.

[2] A few weeks prior to taping, I gave the teachers a release form for their students' parents to sign. Only a couple of students did not return the form, and I simply avoided them with the camera (sometimes by reseating them closer to the periphery of the room).

[3] The biggest challenge of classroom video is recording student voices. I used an external, on-camera microphone, which not all cameras accept; you must look for this feature when shopping. I tried to face the speaking student, as the microphone is most sensitive to sound directly in front of it. As a rule of thumb, I presumed that for adequate audio I needed to hold the camera (and microphone) close enough to students to get a good picture without zooming in.

[4] All teacher names in this article are pseudonyms.

References

Anderson, L. M. (1989). Implementing instructional programs to promote meaningful, self-regulated learning. In J. Brophy (Ed.), *Advances in research on teaching: A research annual, Volume 1* (pp. 311-343). Greenwich, CT: JAI Press.

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco: Jossey-Bass.

Borko, H., Mayfield, V., Marion, S., Flexer, R., & Cumbo, K. (1997). Teachers' developing ideas and practices about mathematics performance assessment: Successes, stumbling blocks, and implications for professional development. *Teaching and Teacher Education, 13*(3), 259-278.

Carpenter, T. P., Fennema, E., Peterson, P. L., Chiang, C-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Education Research Journal, 26*(4), 499-531.

Case Technologies to Enhance Literacy Learning [CTELL]. (n.d.). Retrieved March 11, 2008, from http://ctell.uconn.edu/about.htm.

Cohen, D. K. (1989). Teaching practice: Plus ça change. In P. W. Jackson (Ed.), *Contributing to educational change: Perspective on research and practice* (pp. 27-84). Berkeley, CA: McCutchan.

Cohen, D. K. (1990). A revolution on one classroom: The case of Mrs. Oublier. *Education Evaluation and Policy Analysis, 12*(3), 327-345.

Cohen, E. G. (1994). *Designing groupwork: Strategies for the heterogeneous classroom.* New York: Teachers College Press.

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.

Cuban, L. (1988). Constancy and change in schools (1880 to the present). In P. W. Jackson (Ed.), *Contributing to educational change: Perspective on research and practice* (pp. 85-104). Berkeley, CA: McCutchan.

Greenwood, J.J. (1993). On the nature of teaching and assessing "mathematical power" and "mathematical thinking." *Arithmetic Teacher, 41*(3), 144-152.

Hatfield, M. M., & Bitter, G. G. (2004). A multimedia approach to the professional development for teachers: A virtual classroom. In D. B. Aichele & A. F. Coxford (Eds.), *Professional development for teachers of mathematics: 1994 Yearbook* (pp. 102-15). Reston, VA: National Council of Teachers of Mathematics.

Jacobs, J., Hiebert, J., Givvin, K., Hollingsworth, H., Garnier, H., & Wearne, D. (2006). Does eighth-grade mathematics teaching in the United States align with the NCTM Standards? Results from the TIMSS 1999 video studies. *Journal for Research in Mathematics Education, 37*(1), 5-32.

Johnson, S. M. & The Project on the Next Generation of Teachers. (2006). Why new teachers leave. . . and why new teachers stay. *American Educator*, Summer, 2006, 9-45.

Knight, S. L., Pedersen, S., & Peters, W. (2004). Connecting the university with a professional development school: Pre-service teachers' attitudes toward the use of compressed video. *Journal of Technology and Teacher Education, 12*(1), 139-154.

LessonLab. (2003). TIMSS 1999 video study: Mathematics public release lessons (CD-ROM). Santa Monica, CA: LessonLab.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection*. OTA-HER-616. Washington, DC: U.S. Government Printing Office.

Pailliotet, A. W. (1995). I never saw that before: A deeper view of video analysis in teacher education. *Teacher Educator, 31*(2), 138-156.

Philipp, R. A., Thanheiser, E., & Clement, L. (2002). The role of children's mathematical thinking experience in the preparation of prospective elementary school teachers. *International Journal of Educational Research, 37*, 195-210.

Randi, J., & Zeichner, K. M. (2004). New visions of teacher professional development. In M. A. Smylie & D. Miretsky (Eds.), *Developing the teacher workforce, 103rd yearbook of the National Society for the Study of Education, Part I* (pp. 180-227). Chicago: The University of Chicago Press.

Richardson, V., & Roosevelt, D. (2004). Teacher preparation and the improvement of teacher education. In M. A. Smylie & D. Miretsky (Eds.), *Developing the teacher workforce, 103rd yearbook of the National Society for the Study of Education, Part I* (pp. 105-144). Chicago: The University of Chicago Press.

Sherin, M. G., & van Es, E. A. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of Technology and Teacher Education, 13*(3)*,* 475-491.

Sherin, M. G. (2003). Using video clubs to support conversations among teachers and researchers. *Action in Teacher Education, 4,* 33-45.

Smith, J. (1996). Efficacy and teaching mathematics by telling: A challenge for reform. *Journal for Research in Mathematics Education, 27,* 387-402.

Smith, M. S. (2000). Balancing old and new. *Elementary School Journal, 100*(4), 315-375.

Spillane, J. P. (2001). Challenging instruction for "all students": Policy, practitioners, and practice. In S. Furhman (Ed.), *From the capital to the classroom: Standards-based reform in the states, 100th yearbook of the National Society for the Study of Education, Part II* (pp. 217-241). Chicago: The University of Chicago Press.

Spillane, J. P., & Zeuli, J. S. (1999). Reform and teaching: Exploring patterns of practice in the context of national and state mathematics reforms. *Educational Evaluation and Policy Analysis, 21*(1), 1-27.

Stein, M.K., Smith, M.S., Henningsen, M.A., & Silver, E.A. (1999). *Implementing standards-based mathematics instruction: A casebook for professional development.* New York: Teachers College Press.

Stigler, J. W., Gallimore, R., & Hiebert, J. (2000). Using video surveys to compare classrooms and teaching across cultures: Examples and lessons from the TIMSS video studies. *Educational Psychologist, 35*(2), 87-100.

Technology in Literacy Education [TILE]. (n.d.). Retrieved March 11, 2008, from http://edweb.sdsu.edu/tile.

Toll, C. A., Nierstheimer, S. L., Lenski, S. D., & Kolloff, P. B. (2004). Washing our students clean: Internal conflicts in response to preservice teachers' beliefs and practices. *Journal of Teacher Education, 55*(2), 164-176.

Weiss, I. R., Pasley, J. D., Smith, S. P., Banilower, E. R., & Heck, D. J. (2003). *Looking inside the classroom: A study of K-12 mathematics and science education in the United States.* Chapel Hill, NC: Horizon Research.