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Teaching and Teacher Education 20 (2004) 163–183

TEACHING AND TEACHER EDUCATION

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Teacher learning in the context of a video club

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Received 8 May 2002; received in revised form 10 January 2003; accepted 18 August 2003

Abstract

This paper examines one model of professional development, the use of *video clubs* in which groups of teachers watch and discuss videotapes of their classrooms. Specifically, the paper investigates the learning that occurred as four middle-school mathematics teachers participated in a year-long series of video club meetings. Over time, discourse in the video clubs shifted from a primary focus on the teacher to increased attention to students' actions and ideas. In addition, discussions of student thinking moved from simple restatements of students' ideas to detailed analyses of student thinking. Furthermore, teachers began to reframe their discussions of pedagogical issues in terms of student thinking.

Keywords: Mathematics teachers; Professional development; Teacher learning; Videotape recording

The central goal of mathematics education reform is to improve student learning. Yet researchers and teachers educators recognize that for reform to be successful, there must also be a great deal of teacher learning. Furthermore, like their students, teachers cannot be expected to learn simply by being told what to do. Instead, teachers need opportunities to construct new understandings and to reflect on their learning. But what is it then that teachers need to learn? And what kinds of contexts could support such learning?

Recent research has made a great deal of progress identifying and describing areas in which teachers need to learn in order to implement mathematics education reform (Clarke, 1997; Fennema & Nelson, 1997; Jaworski, 1994; Ma, 1999; Smith, 2000). The need for increased subject matter knowledge and pedagogical content knowledge (Shulman, 1986) are often discussed as is the need to be able to use this knowledge flexibly. In contrast, less work has been done to understand the learning engendered by specific contexts.

This paper examines one model of professional development, the use of *video clubs*. By video clubs, we are referring to meetings in which groups of teachers watch and discuss excerpts of videotapes from their classrooms. Proponents and organizers of video clubs suggest that video clubs offer teachers the opportunity to examine teaching and learning in new ways and have the potential to foster the learning called for by reform. Here this issue is explored through an investigation of the learning that occurred as four middle-school mathematics teachers participated in a year-long series of video club meetings. The central claim of the paper is that changes occurred both in terms of

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0742-051X/$ - see front matter
doi:10.1016/j.tate.2003.08.001

what the teachers chose to discuss in the video clubs, and in terms of *how* these topics were addressed. Specifically, over time, discourse in the video clubs shifted from a primary focus on the teachers to increased attention to students' actions and ideas. In addition, discussions of student thinking moved from simple restatements of students' ideas to detailed analyses of student thinking. Furthermore, teachers began to reframe their discussions of pedagogical issues in terms of student thinking.

This research adds to our understanding of how teachers learn and of the process through which teachers begin to look at classrooms, students, and teaching in new ways. It also enhances our understanding of the role that video can play in supporting teacher learning, that is, how observing classrooms via video influences teachers' perception of classroom interactions. In addition, this research has practical implications. Exploring the design of a new form of professional development can help to improve teacher education. To be clear, this article does not make claims about the influence of video clubs on teachers' classroom practices. While this is an important issue, it is beyond the scope of the current work. Instead, our focus here is to better understand how participating in video clubs can prompt teachers to think about mathematics teaching and learning in new ways.

1. What kinds of contexts support teacher learning?

In this section, two issues in the design of professional development for teachers are considered. First, several characteristics of professional development that have been found to support teacher learning are described. Second, prior research on video clubs is reviewed.

1.1. Supporting teacher learning through professional development

Though current policies stress that students learn by actively building on their previous knowledge, similar experiences for teachers are not always prescribed. In fact, prevailing models of professional development often do little to advance the reform agenda (Little, 1993). Despite this, there are cases of professional development that illustrate teachers learning in the spirit of reform. In a recent review of such programs, Wilson and Berne (1999) highlight three key features of effective professional development programs. First, effective professional development involves "communities of learning that are redefining teaching practice," (p. 194). In suggesting that teacher learning should occur as part of a community, Wilson and Berne echo the claims of many other researchers (Britt, Irwin, & Ritchie, 2001; Cohen, McLaughlin, & Talbert, 1993; Little & McLaughlin, 1993). In addition, they emphasize that participation in this community should involve rethinking the set of activities that define being a teacher. Putnam and Borko (2000) make a similar argument. They suggest that helping teachers learn to think in new ways may require engaging teachers in new kinds of experiences.

Second, Wilson and Berne (1999) claim that "teacher learning ought not be bound and delivered but rather activated," (p. 194). In other words, professional development should not present teachers with a prepackaged set of new pedagogical strategies. Rather, the goal should be to increase teachers' awareness of the potential for learning. Schifter, Bastable, and Russell (1997) describe this process as one in which professional development helps "teachers develop an attitude of inquiry toward their teaching," (p. 257). In addition, Wilson and Berne explain that teachers should have an opportunity to influence the direction and outcome of the professional development program. This is in line with A. Gamoran's (2003) finding that reform-based professional development can result in new resources created by the participating teachers to help sustain their learning.

Third, Wilson and Berne (1999) argue that professional development must involve what Lord (1994) calls *critical colleagueship*, an atmosphere in which members trust each other but at the same time participate in "a professional discourse that includes and does not avoid critique," (p. 195). This is similar to Grossman, Wineburg, and Woolworth's (2001) claim that a key feature of a

teacher community involves the ability to acknowledge that conflict and disagreement exist. This vision of a community contrasts with the typical culture of teaching in which teachers are given a great deal of autonomy within their own classrooms and usually not asked to explain their actions (Wilson, Miller, & Yerkes, 1993). Instead, critical colleagueship appears to share characteristics of a university discourse in which *competitive argumentation* (Schoenfeld, Smith, & Arcavi, 1993) is the norm, that is, in which participants offer competing views of phenomena and work together to make sense of a given situation.

In sum, Wilson and Berne's (1999) characterization of effective professional development emphasizes teachers working together, taking responsibility for their own learning and for the learning of their peers. Much as is advocated for student learning, they articulate the need for teachers to be actively engaged in creating learning experiences that are meaningful for them. The next section explores how the design of video clubs fosters such an environment for teachers.

1.2. Video clubs as a context for professional development

Video was introduced to teacher education in the United States in the 1960s with the advent of portable video equipment. Since that time, a range of video-based programs have been popular from early microteaching sessions (Borg, 1972) to more recent multimedia programs (Lampert & Ball, 1998). One approach that has been used throughout this time is the recording of field observations. Initially such recordings were used mainly as a substitute for a live classroom observation by a supervisor (Olivero, 1965). In the early 1990s, however, such recordings began to be used by researchers and teacher educators in the context of video clubs (Frederiksen, Sipusic, Sherin, & Wolfe, 1998; Gwyn-Paquette, 2001; Sherin, 1998, 2003; Thomas, Wineberg, Grossman, Oddmund, & Woolworth, 1998; Tochon, 1999). In a typical arrangement, a facilitator videotapes participating teachers' classrooms and, with the teacher, selects a short excerpt of video to show at the next group meeting. In the video club, the teachers view the video excerpt and discuss those issues in the video that appeared salient to them. While most reported cases of video clubs involve a teacher educator or researcher who serves as facilitator, there are also cases in which a teacher serves this function for the group or in which teachers take turn performing the role of facilitator.

Recent research suggests that video clubs embody the three features identified by Wilson and Berne (1999) as contributing to effective professional development. First, video clubs are designed to engage teachers as a community and in what Gwyn-Paquette (2001) calls "collaborative reflection." In addition, video clubs redefine practice by engaging teachers in an activity that is very different from their usual classroom practices. For example, during video clubs, teachers do not have to respond immediately to the situation that they view. Thus, unlike teaching, viewing classroom interactions via video can be a time for reflection rather than action. Furthermore, this reflection can take place in the form of repeated viewings of an excerpt of classroom interaction and through fine-grained analysis of this interaction, techniques that are not available to teachers during instruction.

Second, video clubs are designed to promote a stance of inquiry among teachers, not only concerning the video that is viewed but also concerning the video clubs themselves. For example, in the video clubs described by Tochon (1999), which he calls *video study groups*, participating teachers select a specific issue that they want to examine through their work in the video club. Sipusic (1994) describes a different approach in which the individual teacher whose video is being viewed chooses the topic for discussion at that meeting. In both of these designs, the selected video excerpts are not intended to illustrate exemplary teaching or a particular model that participants are expected to emulate. Instead, an explicit goal is to use the video excerpts to question, reflect on, and learn about teaching. Furthermore, ideas that are discussed in the video club become a new resource for group members in their continued exploration of teaching and learning. For instance, Sipusic explains that participating teachers developed a shared language that they

used to watch and discuss video. Similarly, Gwyn-Paquette (2001) claims that video club members developed "new teaching knowledge," (p. 55) through collaborative problem-solving. Gamoran (1994) showed that these resources also extend to the classroom as teachers subsequently used pedagogical strategies that they had viewed initially in the video club.

Third, the notion of critical colleagueship is also an essential component in the design of video clubs. As Wineburg and Grossman (1998) state, "Video clubs offer the potential of opening up the act of teaching to question, comment, and elaboration by a group of supportive peers," (p. 352). Yet, as a result, Thomas et al. (1998) found that teachers expected viewing video to be an evaluative enterprise. In contrast, the teachers discussed in this paper came to use video not as a resource for evaluating each other's practices, but rather as a resource for trying to better understand the process of teaching and learning.

2. Research design

This research took place in the context of the *Fostering a community of teachers as learners* project (Shulman & Shulman, 1994). As part of this project, researchers designed and tested several different approaches to professional development. One approach was the use of video clubs as forum for teachers to examine and reflect on their practices.

2.1. Video club context

During the 1996–1997 school year, four mathematics teachers from Nile Middle School[1] participated in a video club. Nile Middle School is located in the San Francisco Bay area. It is one of two middle schools in its district and houses approximately 1000 students. At the time of the study, 80% of the student population came from upper-middle class families in the neighborhood. The other 20% were bused to Nile from less affluent areas. Overall, the student body was 70% Caucasian, 20% Asian, 5% African American, and 5% other ethnicities.

There were five seventh- and eighth-grade mathematics teachers at the school, all of whom were invited to participate in the video club. Four teachers accepted, citing two main reasons. Above all, the teachers explained that they looked forward to the opportunity to collaborate with their colleagues. In departmental meetings the focus was usually on administrative issues and they valued the chance to discuss more substantive issues related to teaching and learning. To a lesser extent the teachers also expressed interest in viewing video of themselves and their peers. A fifth teacher declined to participate explaining that she would be retiring at the end of the year and was not interested in participating in any new activities.

The four participating teachers had a range of teaching experience. John Yee[2] had taught for 28 years and David Louis had taught for 4 years. The two remaining teachers, Nancy Martin and Ron Pine were both first year teachers. Though the initial design of the video club called for all teachers to share excepts of video from their classrooms, once the video clubs were underway, John and Nancy declined to do so citing that they were "self-conscious about being videotaped." Thus, at each video club, excerpts from either David's or Ron's classroom were watched and discussed. We will comment further on this issue in the discussion of results.

Two researchers also participated in the meetings, one as a facilitator and a second as a participant observer. The researcher-facilitator (the first author) had previous experience working with teachers to discuss videos of mathematics classes (Frederiksen et al., 1998; Sherin, 2003). Through this work, she had developed a particular perspective on viewing video with teachers that she planned to apply in the current study. The basis for this perspective was Frederiksen's (1992) notion that when watching video, people notice particular events as significant. He calls these

[1] Nile Middle School is a pseudonym.

[2] John Yee, Nancy Martin, and Ron Pine are pseudonyms. David Louis chose to have himself identified by his real name in this paper.

events "call outs" referring to the idea that one will literally "call out" when one sees something of note. Drawing on this idea, the researcher had two related goals. First, she wanted to understand the kinds of issues and events that the teachers paid attention to as they watched video excerpts, in other words, what served as "call outs" for the teachers. Second, the researcher wanted to explore whether teachers' attention might be drawn to call outs related to student thinking—a topic that she hypothesized was particularly salient to mathematics education researchers as they viewed video (see Sherin, 2001, for a further discussion of this issue).

In light of these goals, the researcher typically participated in the video clubs in two main ways. First, many of her comments were intended to elicit the teachers' ideas about what stood out to them in the video excerpts. Related to this, the researcher often asked a teacher to clarify or expand upon a comment that he or she made or to explain the connection between a particular comment and what was viewed in the video. Second, the researcher also participated in the video club by focusing the teachers' attention on issues related to student conceptions—asking, for example, about the meaning of a student's statement or idea.

2.2. Video club meetings

The video club meetings took place once a month from September through June, for a total of 10 meetings over the course of the year. The first seven meetings generally shared the same format. Prior to each meeting, one of the researchers would videotape a teacher's class. The videotaping took place using a single camera along with three external microphones. Audio from the three microphones was combined using an audio mixer at the time of recording. In general, the camera followed the speaker (teacher or student) during whole-class discussions. During small group or individual seat work, the camera followed the teacher as he circulated throughout the classroom. Following the videotaping, the researcher and teacher met together to review the videotape and to select an excerpt to show at the video club. The researcher would prepare a transcript of this excerpt for the group meeting. The selected excerpts were approximately 6 min long and typically came from whole-class discussions.

Each video club took place after school and lasted approximately 40 min. The teacher whose video was being shown would set the context for the lesson and the group would watch the video. One of the researchers would then begin the discussion quite generally by asking, "Any comments?" or "What did you notice?" At the first meeting, two video excerpts were viewed. The teachers commented, however, that they did not have enough time to discuss what they had noticed in the second clip. Thus, the group decided to watch only one clip at each of the future meetings.

The final three video clubs had a different format. As a culminating activity, the teachers chose to have a day-long in-service in which they would talk with a teacher-researcher about using video to study teaching and learning. The April meeting was spent planning for this in-service. The in-service then occurred in May, taking the place of the regular video-club meeting. And in June, the teachers met together to debrief and discuss their experiences in the video club during the past year. All 10 of the video clubs were videotaped and transcribed.

2.3. Data analysis

Data analysis focused on the first seven video clubs meetings and consisted of several iterative cycles. To start, two researchers independently examined the transcripts of these meetings and noted where there was a change in topic. This resulted in each transcript being divided into a set of individual segments. Initial agreement between the two researchers on the resulting segments of transcripts was 90.8%. The researchers then met together to review the points of disagreement and reached consensus.

Next, selected segments from each of the video clubs were used to identify the kinds of issues that were discussed in the meetings. Five topics were identified: (a) pedagogy, (b) student conceptions, (c) classroom discourse, (d) mathematics, and (e) other. Segments relating to pedagogy concerned

the teacher's actions and decisions, and the teaching strategies that were used in the lesson. Segments about student conceptions concerned students' understanding of the mathematical ideas in a given lesson. This included general comments about the understanding of the class as a whole as well as comments about the ideas of individual students. The third category, classroom discourse, involved the ways in which the teacher and students communicated and discussed their ideas, for example, whether a large number of students had participated in a discussion or how students knew when it was their turn to talk. Segments about mathematics consisted of questions and comments about the mathematics in a lesson aside from what students understood about the topic. Thus, such discussions focused on the teachers' own understandings of mathematics. The fifth category, other, included comments that did not fit into any of the previous categories, for example, comments about the quality of the audio or video. The first four categories were intended to capture the teachers' substantive comments about what was happening in the video.

With these categories and definitions in mind, the two researchers proceeded to code the segments of transcript that had been identified previously. The researchers independently assigned one of the five categories to each segment of transcript. Initial agreement on the coding was 86.6%. The researchers then reviewed the points of disagreement, refined the definitions of the categories as needed, and were able to reach consensus on all of the segments.

Using this information, the amount of time spent discussing each topic in each of the seven video clubs was calculated. In addition, it was noted whether the first speaker in each segment was a teacher or researcher. Following this, the number of segments per topic that were initiated by the teachers and the number that were initiated by the researcher were determined.

In the final stage of coding, selected segments related to the two most frequent topics, student conceptions (42% of the total time) and pedagogy (35% of the total time), were examined for changes in the ways that teachers discussed these topics over time. This resulted in the identification of three different types of discussions concerning student conceptions and of two criteria that distinguished among segments related to pedagogy. Two researchers independently coded the segments related to student conceptions in terms of the three categories and had 100% agreement. The researchers then coded the segments related to pedagogy in terms of each of the two criteria that had been identified. For the first criteria, whether or not teachers offered alternative pedagogical suggestions, the researchers initially had 93% agreement, and consensus was reached through further discussion. With respect to the second criteria, whether or not segments of pedagogy related to issues of student conceptions, the researchers had 100% agreement.

3. What happens in a video club? A look at two video club meetings

We now describe the discussions that took place during the first and seventh video club meetings. The goal at this point is to give the reader a flavor of the kinds of issues that the teachers explored in these two meetings. This information is summarized in Tables 1 and 2.

3.1. Video club 1[3]

At the first video club meeting, the group watched an excerpt from David's classroom in which students reviewed a homework assignment on interpreting graphs (Fig. 1).[4] Most of the discussion in class concerned whether graph (f) could be a realistic representation of a flag being hoisted. Some students suggested that graph (f) was not realistic while others argued that it could

[3] Although two video excerpts were viewed at this meeting, due to space constraints, this summary focuses only on the discussion of the first excerpt. Furthermore, segments of discussion coded as other are not presented in this summary. As stated previously, such segments typically concerned issues outside of what was happening in the video.

[4] This assignment is from Swan, M. (Ed.). (1985). The language of functions and graphs: An examination module for secondary schools. Manchester: Joint Matriculation Board, Shell Centre for Mathematical Education.

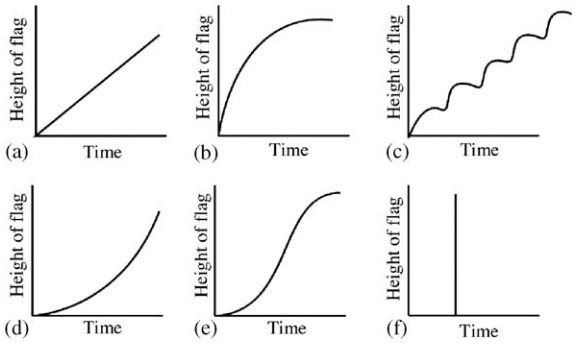

Fig. 1. Which graph is the most realistic representation of a flag being hoisted?

be realistic if the flag was hoisted instantaneously or, as Sam said, "if you have a really long flag."

After watching the video, the researcher-facilitator asked, "[Any] comments on what the students were saying?" David responded, but focused instead on the teacher's role in the discussion. Specifically, he asked if it was appropriate for him to have had a lengthy discussion of graph (f) with the class.

David: You know as teachers you make decisions right on the spot about explore it or don't explore it and how much math can be learned from it. And I probably wouldn't have said anything [about graph (f) except that] Sam makes a comment about "Is it possible?" And I felt like as soon as he made that point, then lots of kids started to talk, and I felt like, "Okay [I'm going to go with this.]" I could have just said, "Let's move on." But I didn't.

In this quote, David explained that he had not planned to discuss graph (f) with the class. Yet after Sam asked if graph (f) was a realistic representation, David decided to pursue the issue with his class. Nevertheless, David was not sure if focusing for so long on graph (f) was the right "teacher move." The teachers discussed David's concern and suggested ways that he might have engaged students in discussing other graphs as well. John then asked David to elaborate what he meant when he said, "Kids started to talk." After discussing this briefly, the researcher asked what it was students were saying about graph (f). In response, the teachers began to list various students' statements. "[Amy] says, 'It's not very realistic.'" "Ben says, 'I goofed.'" However, before going into detail concerning the meaning of these statements, one of the teachers directed the conversation to a new topic by asking David about his goals for the lesson.

Ron: I was just sort of wondering… What was it that you wanted [the students] to leave with? I mean, before this [discussion of graph (f)] comes up … did you actually have a plan?

The teachers then discussed what it was that David had hoped to accomplish that day. David explained that an important goal for him was to have students talking about their ideas in class. Therefore he had asked for a student volunteer to explain what one of the graphs meant. "Several kids raised their hand and I just picked on Amy." The researcher followed up on David's mention of a particular student by directing the conversation to what the student had said.

Researcher: It's even sort of funny…what [Amy] said. All she says is "Graph (f) went all the way up, but no time." It's not that descriptive, what she said.

The teachers agreed that Amy's statement was not very descriptive and commented that when she later discussed graph (f) Amy said, "It's not really realistic." The researcher then asked the group why they thought graph (f) was interesting to students. The teachers hypothesized that the students' attention was drawn to graph (f) because it looked different from the other graphs on the handout.

Ron: Even just the way that graph looks doesn't look like anything that they're used to…We usually have this [line], either it squiggles, or it curves, or it goes straight. But (f) is just this straight up and down. I just don't think it looks

Table 1
Summary of video club 1

Segment #	Initiated by whom	Topic	Details
Watch video clip			
1	Researcher	Student conceptions	What did the students say?
2	Teacher	Pedagogy	Should the teacher have allowed discussion of graph (f)?
3	Teacher	Discourse	What does it mean to "have students talking?"
4	Researcher	Student conceptions	What did the students say about graph (f)?
5	Teacher	Pedagogy	What were the teacher's goals for the lesson?
6	Researcher	Student conceptions	What did Amy understand about graph (f)?
7	Researcher	Student conceptions	Why did students focus on graph (f)?
8	Researcher	Student conceptions	What did Sam and Jeff say about graph (f)?

like what they're used to and so they don't know what to do with it.

Nancy: Yeah. It's different, it's the oddball.

John: And some students may have thought graph (f) was, literally, the flag pole.

The teachers had a final discussion about students' ideas when prompted by the researcher to compare Sam and Jeff's comments about graph (f). Both of these students talked about the flag as being at "the top and bottom at the same time" though Jeff was using this as an explanation for why graph (f) was not realistic while Sam, in contrast, was using this as an argument for why graph (f) was possible "if you have a really long flag." The teachers concluded that Sam was building on what Jeff had said, though Sam probably did not realize that he was contradicting Jeff's claim.

Researcher: Do you think that's why, that's how Sam came up with this idea about if you have one really long flag, if it's at the top and the bottom?

Ron: It could be. It could be he's imagining this is a flag pole, and if I take a flag big enough and put it on this graph… it could be in all places.

John: I think he got it from Jeff's comment. Jeff was making a comment to prove that it was impossible. And then Sam took that and said well, if you had a really long flag, it could be at both places at the same time. So he was actually taking a comment and turning it around.

David: I agree…he's reacting to Jeff's comment.

John: But [Sam] sure didn't get Jeff's point.

3.2. Video club 7

The group continued to meet each month, and seven months later the following discussion occurred. As in video club 1, participants viewed a whole-class discussion from one of David's classes. In this lesson, students examined the relationship between the number of power boat registrations and the numbers of manatees killed off the coast of Florida.[5] A handout given in class provided two sets of data. At the top of the page was a list of the number of manatees found dead at fourteen different points in time, from least to most recent (Fig. 2).

Further down on the page was a table that provided the number of manatees killed at a particular time along with the number of power boat registrations at that time (Fig. 3). In discussing this information in class, students argued about whether the number of manatee deaths was correlated to the number of power boat

[5] This activity is from the National Center for Research in Mathematical Sciences Education & Freudenthal Institute (Eds.). (1998). Mathematics in context. Chicago: Encyclopedia Britannica.

13, 21, 24, 16, 24, 20, 15, 34, 33, 33, 39, 43, 50, 47

Fig. 2. Number of manatees killed in order of times recorded.

Power boat registrations in thousands	Manatees killed
447	13
460	21
481	24
498	16
513	24
512	20
526	15
559	34
585	33
614	33
645	39
675	43
711	50
719	47

Fig. 3. The number of manatees killed and the number of power boat registrations at that time.

registrations, in other words, whether a relationship existed between these two variables.

After watching the video, the teachers initiated a lengthy discussion concerning the students' approach to examining the data on the handout. David began by observing that students were not "analyzing the data" in a systematic way. "They were just speculating on what they might find." Others concurred. Nancy then asked which data students were examining. "[Did some] kids focus on the table? And some were focusing on the [list]?" In exploring this issue, the teachers argued that Brenda's comments indicated that she was looking only at the number of manatees killed. In contrast, Glen and others were talking about "correlation" and thus "must be looking at the relationship between the two lists, the number of powerboats and the number of manatees."

The researcher then noted that students seemed comfortable disagreeing with each other. A brief discussion followed concerning the ways that students communicated with each other in the video. Several participants commented on the friendly banter that existed as students challenged each other's ideas.

Next, the researcher returned to the issue that Nancy had raised earlier concerning whether students were referring to the list of individual numbers or to the two-column table. Using the transcript as a resource to review what students had said, the teachers compared the comments of several students. They concluded that Brenda and Samir were looking at the list of individual numbers and that Glen and Jeff were looking at the table of numbers. Furthermore, they noted that Glen was the first to propose that the numbers in the two columns were both increasing and were therefore correlated.

David: One thing was [to] look at the list of numbers [and see that] the number of manatees that are killed is going up higher and higher.

Nancy: Right. (Looks at transcript.) Samir says, "It goes up." Brenda says, "It goes up and then goes down, like at the very bottom it goes from 50 to 47." [See Fig. 2.]

Ron: So that's talking about…just one set of numbers.

John: But then Glen clearly said that the more power boats there were, the more manatees would have been killed.

Ron: …And later Glen says, "If you graphed it, you'd have an almost linear line." …

John: That's where they're starting to talk about correlation. So he's looking at the two columns instead of the one.

David: Glen, yeah. Glen is the first and Jeff is the second.

After examining the students' comments further, Ron appeared puzzled and asked, "What is Brenda talking about?" He noted that even though, initially, she seemed to be talking about the number of manatees killed without considering the number of power boat registrations, later she stated, "There's a medium correlation because they're all like in the same number range, but they go up and down." Since correlation generally describes the relationship between two sets of numbers, the teachers wondered if Brenda was

now talking about the number of manatees killed and the number of power boat registrations. A discussion followed in which the group considered whether it made sense, mathematically, to describe the correlation within a single data set.

Researcher: Can you have correlation with one set of data?
Ron: Well, you can if you take them…if you see them as ordinal numbers…
Nancy: Maybe they were just looking at 1, 2, 3, 4, 5.
John: They have to be correlated to something.
David: Yeah. Maybe Brenda was correlating it to order.

Following this, the teachers returned to their discussion of Brenda. David and Ron argued that Brenda was looking at only one set of data throughout the discussion. They suggested that by using the term "correlation" she was informally examining the numbers to see if they were steadily increasing. Specifically, Ron stated, "She's just looking at the numbers in order. She sees that as a linear relationship." In contrast, John argued for a different interpretation of Brenda's comments. He claimed that in the latter part of the discussion, like Glen, Brenda was considering the degree of correlation between the number of power boat registrations and the number of manatee deaths. "I don't think she was looking at just one column… . I bet she realizes that the number of power boat registrations in the left column [of Fig. 3] are [also] going up. And if she [instead had seen] some inconsistency in that progression… she would say it was not a very good correlation." Nancy was less sure, suggesting only, "[Brenda] was confused."

The group decided to return to the video to watch the rest of the discussion that took place in David's class. Afterwards, the researcher asked if they now had a better sense of Brenda's thinking. The teachers considered what Brenda said in the continuation of the discussion and compared her comments to those of other students in the class. The teachers reached consensus and agreed that Brenda was aware that that both number of power boats registrations and the number of manatee deaths increased over time, and that the two sets of data were related.

At this point, John directed the group to an issue that students raised in the second half of the discussion concerning whether the power boats had played a role in the death of the manatees. John believed the students were "jumping to try to draw conclusions before they determine whether the data has any correlation."

John: I think normally you would take a look at the data. The question was, "Was there a correlation between powerboat registrations and the manatees killed?" And you would say, "Yes, there is," or "No there isn't," before you'd get into saying "What does that mean?" "What is 'the powerboat registration today?"' Does that mean there are more boats in the water? Does "the manatees killed" mean just ones that were killed by boats or are there some that died by disease?
Ron: I think they're pretty well convinced …that there is a relationship. And then they go into "Okay. Now let's look at the powerboats. …Are they causing the death of the manatees?"
John: But they never even got into what correlation might mean, the word, or what kind of relationship there might be between those numbers. It was just, "Okay, these go up, and these go up." …The issue of whether those two columns are correlated wasn't [resolved].

John was surprised that students would question the legitimacy of the correlation between the number of power boat registrations and the number of manatees killed before trying to be more precise mathematically about the strength of the correlation that existed. In response, the teachers began to look more closely at the comments that were made about correlation. For example, Ron stated, "I counted seven kids who at some point said something to the effect that there's correlation. … So I saw them reaching consensus on that."

Table 2
Summary of video club 7

Segment #	Initiated by whom	Topic	Details
Watch video clip			
1	Teacher	Student conceptions	What was the students' approach to analyzing the data?
2	Teacher	Student conceptions	Were students looking at one or both sets of data?
3	Researcher	Discourse	Are students comfortable disagreeing with each other?
4	Researcher	Student conceptions	Were students looking at one or both sets of data?
5	Teacher	Student conceptions	What does Brenda understand?
6	Researcher	Mathematics	Is it is possible to have correlation with one set of data?
7	Teacher	Student conceptions	What does Brenda understand?
Watch video clip			
8	Researcher	Student conceptions	What does Brenda understand?
9	Teacher	Student conceptions	Why did students discuss effect of powerboats before being more precise about correlation?
10	Teacher	Student conceptions	What did students say about correlation?
11	Teacher	Pedagogy	What were the teacher's goals for the lesson?

David then commented on the class discussion from a pedagogical perspective. He explained that his goal at this point was to have students raise a range of ideas related to the data and that later in the day they would examine the issue of correlation in a more mathematically precise way.

David: This was a pre-discussion to the activity they were going to do. So as a teacher, I wasn't trying to get consensus about [the degree of] correlation, I was trying to get some ideas out there so kids had something to think about [later on] when they did the graph and analyzed it for correlation… . This wasn't a discussion about their conclusions, this was kind of a "Here's some data, what are your thoughts on this?" [kind of discussion].

4. New ways to explore teaching and learning

The previous descriptions of video clubs 1 and 7 provide a sense of two very different kinds of discussions about mathematics teaching and learning. In particular, there are differences in the topics that were discussed most frequently and in whether a teacher or researcher initiated the discussion of these ideas. Furthermore, even when the teachers discussed the same types of issues, they seemed to have different goals in mind. Below, these changes are examined in greater detail.

4.1. Changes in what the teachers discussed

4.1.1. From video club 1 to video club 7

One of the most salient differences between video clubs 1 and 7 concerns that topics that the teachers raised for discussion, and in particular whether the teachers focused on pedagogical issues or on student conceptions. In video club 1, pedagogical issues were the primary interest of the teachers. David's initial question to the group concerned whether he should have allowed a lengthy discussion of graph (f). Despite the researcher asking the group to comment on what the students were saying, what was of interest to David was what he, the teacher, had done. And the other teachers responded to David's question. Later in the meeting, Ron brought up another pedagogical issue by asking about David's goals for the lesson. Interestingly, Ron's comment came as the researcher had once again prompted the teachers to look at students' comments, and they had begun to do so. Yet a single question from Ron about David's goals quickly turned the conversation away from student thinking and

Table 3
Number (and %) of teacher-initiated segments of discussion per topic

Video clubs	Student conceptions	Pedagogy	Discourse	Mathematics	Total
1[a]	1 (14%)	4 (57%)	1 (14%)	1 (14%)	7 (100%)
2	5 (33%)	4 (27%)	4 (27%)	2 (13%)	15 (100%)
3	1 (13%)	4 (50%)	2 (25%)	1 (13%)	8 (100%)
4	4 (50%)	3 (38%)	1 (13%)	0 (0%)	8 (100%)
5	4 (40%)	3 (30%)	1 (10%)	2 (20%)	10 (100%)
6	3 (30%)	4 (40%)	2 (20%)	1 (10%)	10 (100%)
7	6 (86%)	1 (14%)	0 (0%)	0 (0%)	7 (100%)
Total	24	23	11	7	65

Note. Due to rounding, some of the percent totals may add up to more than 100%.

[a] The data for video club 1 includes the discussions of both video excerpts that were viewed. For that reason, the total number of teacher-initiated discussion segments is greater than what is listed in Table 1.

towards a focus on the teacher's actions. It appears that when asked to comment on the video, what was natural for the teachers at this point was to focus on what the teacher in the video was doing.

In contrast, in video club 7, the teachers initiated a great deal of discussion about student conceptions. Without prompting from the researcher, they examined the students' approach to data analysis, looking closely at students' comments in order to interpret which data were being investigated. In addition, the teachers discussed the understanding of a particular student, Brenda, on multiple occasions. This suggests that they now valued making sense of student thinking and were willing to discuss such issues in detail and at length. Near the end of the video club, one of the teachers raised a pedagogical issue for discussion, asking about the teacher's goals for the lesson. Thus, what the teacher in the video was doing was still of interest to the group, but it was not the central focus of their analysis.

To be clear, student conceptions was a topic of discussion in video club 1. However, it was the researcher, not the teachers, who focused the group's attention on this issue. And in two of the five instances, the teachers dismissed the researcher's questions and discussed pedagogical issues instead. Furthermore, on the remaining occasions, when the teachers did respond to the researcher's prompting about student conceptions, it was mostly at a superficial level. For example, the teachers quoted from the transcript when asked what students said, but they did not examine the meaning of these comments. Only near the end, when prompted by the researcher to compare Sam and Jeff's comments about graph (f), did the teachers begin to interpret students' ideas. And even then, the conversation that took place was quite brief. In video club 7, in contrast, the teachers controlled most of the discussions of student conceptions. While the researcher continued to initiate some discussion of student thinking, the specific issues that the researcher raised were those that had been brought up earlier by the teachers.

4.1.2. Changes across all video clubs

These differences in the topic of conversation in video clubs 1 and 7 reflect general trends that exist across the seven video clubs. First, throughout the video clubs, pedagogy and student conceptions were the topics most often raised by the teachers (Table 3).[6] Second, initially the teachers placed more emphasis on raising pedagogical issues for discussion than on raising issues related to student conceptions. Specifically, in video clubs 1 and 3, 50% or more of the discussion segments initiated by the teachers were coded as pedagogy, while less than 15% of the segments they initiated were

[6] In an effort to focus on the substantive comments that the teachers made about video, segments coded as other are not included. Note that such comments comprised only 4% of the teacher-initiated discussion segments.

Table 4
Number of teacher- and researcher-initiated segments

Video clubs	Teacher-initiated segments					Researcher-initiated segments					
	Student conceptions	Pedagogy	Discourse	Mathematics	Total	Student conceptions	Pedagogy	Discourse	Mathematics	Total	Combined total
1	1	4	1	1	7	8	0	0	0	8	15
2	5	4	4	2	15	3	1	1	2	7	22
3	1	4	2	1	8	3	1	1	0	5	15
4	4	3	1	0	8	2	1	1	0	4	12
5	4	3	1	2	10	1	1	0	0	2	12
6	3	4	2	1	10	0	0	2	1	3	13
7	6	1	0	0	7	2	0	1	1	4	11
Total	24	23	11	7	65	19	4	6	4	33	98

coded as student conceptions.[7] Third, in the later video clubs, the teachers maintained a strong interest in pedagogy, though they also began to initiate conversations around students' ideas. For example, in video clubs 4, 5, and 6, the teachers initiated pedagogical issues, on average 36% of the time, while they raised issues relating to student thinking 40% of the time. Finally, in video club 7, the teachers' emphasis is heavily on student conceptions (86%), and they initiate a discussion of pedagogical issues only once (14%). While it is not clear whether video club 7 represents a trend that would have continued in additional meetings, what is clear from the data is that, over time, the teachers came to initiate discussions of student thinking with greater frequency.

Thus far, the evidence presented supports the idea that the teachers became increasingly focused on student thinking. Yet the question remains as to whether the teachers actually discussed student conceptions with greater frequency over time. Table 3 lists only the segments initiated by the teachers and does not include those segments initiated by the researcher, nor does it take into account the length of time of the discussion segments.

To address this issue, first compare the number of teacher-initiated segments with the number of researcher-initiated segments (Table 4). Note that the majority of researcher-initiated segments concerned student conceptions. This is not surprising given the researcher's stated goals. Yet in addition, while the number of teacher-initiated segments remained fairly constant across the video clubs,[8] the number of researcher-initiated segments decreased over time—both in terms of the number of student-conceptions segments that were initiated and in terms of the overall number of segments that were initiated. This suggests that over time, the teachers became increasingly in control of what was discussed in the video club.

Second, for each video club the percentage of the total discussion time in which the group talked about each of the four topics was calculated (Table 5). Overall, Table 5 confirms the patterns presented in Table 3. Specifically, in video clubs 1 and 3, more time was spent discussing pedagogy than student thinking. Yet in video clubs 4–7, the opposite is true, with the percentage of time spent discussing student conceptions higher than that of pedagogy. Together with the researchers'

[7] This pattern does not hold for video club 2. In that meeting, the teachers initiated approximately twice as many discussion segments as they did in video clubs 1 or 3, and the issues raised ranged across all four content areas. We believe that this represents a period of initial experimentation on the part of the teachers in which their goal was to raise issues for discussion in the video club. However, they had not yet developed the ability to discriminate in what they raised for discussion. In fact, seven of the 15 issues that the teachers raised were discussed for less than 20 s. Notably, this included three of the five segments that they initiated concerning student conceptions.

[8] Except for video club 2.

Table 5
Percent of total discussion time per topic

Video clubs	Student conceptions (%)	Pedagogy (%)	Discourse (%)	Mathematics (%)	Total (%)
1	33	46	14	7	100
2	41	24	30	5	100
3	31	55	13	1	100
4	62	18	19	0	100
5	48	29	4	20	100
6	42	36	9	13	100
7	64	18	13	6	100

decreasing role in the video club, this confirms an increased emphasis on the part of the teachers to examine student thinking.[9]

In sum, these data suggest that the teachers maintained an interest in pedagogical issues throughout the video clubs. In addition, the teachers developed a new focus on student conceptions, frequently initiating discussions on this topic and talking about the issues raised at length. In the next section, the teachers' discussions of student conceptions and pedagogy are examined further as changes in the ways that the teachers explored these two topics are described.

4.2. Changes in how the teachers discussed student conceptions and pedagogy

4.2.1. Changes in the teachers' discussions of student conceptions

In addition to the teachers' increasing focus on student conceptions, the way that they came to talk about students' ideas changed over the course of the video club. Specifically, we identified three levels of analysis through which the teachers examined student thinking. Each level represents an increasingly complex way to explore students' ideas.

Level 1 involves simply stating what a student had said. Such statements were often read directly from the transcript of the classroom video. For example, during video club 1, the researcher asked what students were saying about graph (f). The teachers responded by listing various student comments. "[Amy] says, 'It's not very realistic.'" "Ben says, 'I goofed.'"

Unlike level 1, level 2 comments involve some analysis of students' thinking in an effort to try to understand the meaning of students' comments or methods. For example, in video club 7, the teachers repeatedly examined Brenda's thinking. They worked to make sense of which data she was investigating and to try to understand what she meant when she said that there was a "medium correlation."

Finally, level 3 involves generalization and synthesis of students' thinking. For example, near the end of video club 7, the teachers synthesized what the students had said about correlation, trying to understand the different ways that this concept was discussed and whether consensus was reached. Another level 3 instance occurred earlier in the same meeting when David suggested that the students were not analyzing the data presented in a systematic way and were "just speculating on what they might find." This discussion went beyond an analysis of the meaning of students' ideas. In addition, the teachers were attempting to characterize the nature of students' exploration of the data.

Over the course of the video clubs, the teachers engaged in all three types of analysis. Table 6 illustrates the highest level of analysis that was reached for each student-conceptions segment. This table reveals that the majority of discussions in the early video clubs were focused on level 1. In addition, in video club 1 there were two occasions on which teachers did not respond to the researcher's suggestions to examine student

[9] Video club 2 does not follow this trend. However, as discussed previously, we believe that the teachers were experimenting at this point with discussing a variety of issues.

Table 6
Levels of analysis of student thinking

Video clubs	No response to prompt to examine student thinking	Level 1: Quote student statement	Level 2: Explore meaning of student statement	Level 3: Synthesize student ideas	Total
1	2	4	1	2	9
2	0	4	3	1	8
3	0	2	1	1	4
4	0	1	4	1	6
5	0	0	4	1	5
6	0	1	1	1	3
7	0	0	4	4	8

Table 7
Comparison of teacher- and researcher-initiated analyses of student thinking

Video clubs		No response	Level 1	Level 2	Level 3	Total
1	Teacher-initiated	0	1	0	0	1
	Researcher-initiated	2	3	1	2	8
2	Teacher-initiated	0	3	2	0	5
	Researcher-initiated	0	1	1	1	3
3	Teacher-initiated	0	0	1	0	1
	Researcher-initiated	0	2	0	1	3
4	Teacher-initiated	0	0	3	1	4
	Researcher-initiated	0	1	1	0	2
5	Teacher-initiated	0	0	3	1	4
	Researcher-initiated	0	0	1	0	1
6	Teacher-initiated	0	1	1	1	3
	Researcher-initiated	0	0	0	0	0
7	Teacher-initiated	0	0	3	3	6
	Researcher-initiated	0	0	1	1	2

thinking and instead shifted the conversation to a different topic. In contrast, in video clubs 4–7, the teachers began to engage in a great deal of analysis at levels 2 and 3, and there were few instances of level 1 analysis.

This pattern is even more striking when we compare the teacher and researcher-initiated comments related to student conceptions (Table 7). In the first three video club meetings, all of the level 3 analyses that occurred were initiated by the researcher. In other words, it was the researcher who had identified the level 3 issue that the group then discussed. In contrast, in video clubs 4–7, the teachers initiated almost all of the level 3 analyses. This suggests that, over time, the teachers not only developed increasingly sophisticated ways to analyze student thinking, but that in addition, the issues that they themselves selected for analysis became more complex.

4.2.2. Changes in the teachers' discussions of pedagogy

Over the course of the video clubs, the teachers also developed a new approach to discussing pedagogical issues. To examine this, first note that there were two types of conversations that ensued

when the teachers explored pedagogical issues in the video clubs. One type of conversation raised questions about what the teacher in the video had done and offered alternative pedagogical strategies that the teacher in the video might have used. For example, in video club 1, David asked whether it was appropriate for him to have had a lengthy discussion of graph (f) with the class. The teachers discussed David's question and suggested ways that he might have engaged students in discussing other graphs from the assignment.

In the second type of discussion, the teachers explained the methods that the teacher in the video had used. Thus, rather than suggest what the teacher *might have done*, here the purpose was to explain what the teacher *did do*. The discussion of David's teaching in video club 7 illustrates this approach. Here, David suggested that he had framed the activity as an introduction to the data presented. Furthermore, he argued that the students' approach to data analysis made sense given what he had been trying to accomplish in this portion of the lesson.

Over the course of the seven video clubs, there were multiple occurrences of both kinds of discussions of pedagogy. Table 8 displays the distribution for the teacher-initiated discussions of pedagogy.[10] There appears to be a slight tendency early on to make comments in which alternative teaching strategies were suggested, and in the latter video clubs to try to explain the teachers' comments and methods.

Furthermore, over time, the teachers came to examine pedagogical issues in terms of student thinking. For example, in video club 1, the teachers offered alternative pedagogical strategies that David could have used to engage students in talking about the different graphs that were presented in the lesson. The focus of the discussion was on general pedagogical techniques for engaging students in discourse. In contrast, in video club 6, John suggested additional questions that David might have wanted to use in light of the particular mathematical ideas that students were examining. The focus in this case was on how questions from the teacher might have been used to push the students' understandings further.

Table 8
Teacher-initiated discussions of pedagogical issues

Video clubs	Explorations of alternative teaching strategies	Explanations of teaching strategy used
1	3	1
2	3	1
3	3	1
4	2	1
5	0	3
6	2	2
7	0	1

A similar shift occurred in the teachers' efforts to explain the pedagogical strategies that had been used. For instance, in video club 1, Ron asked about David's goals for the day. In response, the group discussed how David implemented the lesson, and David mentioned that he had wanted students to talk in class. However, he did not discuss his goals for student understanding nor were his actions examined in terms of the ideas that students raised in class. In contrast, in video club 7, the teachers discussed David's goals for the lesson with particular attention to the student thinking that they had analyzed earlier in the video club. Specifically, they compared the students' ideas about correlation with what David had hoped to accomplish in this part of the day's lesson.

As shown in Table 9, in the first three video clubs, pedagogical issues were discussed independent of students' understandings. Later, however, there was more of an emphasis on relating the teachers' actions to what the participants understood about student thinking. Thus, the teachers moved away somewhat from their focus on alternative pedagogical strategies—from a perspective on pedagogy as something that should be fixed—to a focus on pedagogical as something that should be explored and understood, and

[10] Of the four researcher-initiated pedagogy segments, one involved exploring alternative pedagogical strategies. This occurred in video club 2. The remaining researcher-initiated comments about pedagogy all involved trying to understand the teacher's approach.

Table 9
Developing connections between pedagogical issues and student thinking

Video clubs	Exploration of alternative teaching strategies		Explanation of teaching strategy used	
	Independent of student thinking	In light of student thinking	Independent of student thinking	In light of student thinking
1	3	0	1	0
2	3	0	1	0
3	3	0	1	0
4	1	0	0	2
5	0	0	0	3
6	0	2	0	2
7	0	0	0	1

understood particularly in light of students' conceptions.

5. Discussion

This paper provides evidence that as teachers participated in a video club, they began to focus on different aspects of classroom interactions and developed new approaches to analyzing both pedagogy and student conceptions. Yet because of the small data set on which this study is based, it is not clear whether similar changes could be expected to occur in a different video club. Instead, some of what took place may be due to the specific group of teachers who were involved or to the particular video excerpts that were viewed. Additional studies would need to be conducted before being able to make claims about the generalizability of the results that have been presented here. Nevertheless, a number of research studies have shown that teachers tend to view video with a focus on the teacher in the video and with an evaluative stance towards what the teacher in the video is doing (Friel, 1997; Hammer, 2000; Richardson & Kile, 1999). Therefore, we suspect that in any video club teachers would be likely to begin, as in this case, with a focus on pedagogy and on alternative pedagogical strategies that the teacher in the video might have used. However, the question remains as to whether other groups of teachers would begin to focus on student conceptions and to connect their analyses of pedagogy and student thinking as the teachers in this study came to do.

In addition to making claims that the teachers in this study began to discuss classroom interactions in new ways, it is important to also understand how these changes reflect learning on the part of the teachers. Specifically, what kind of knowledge have the teachers acquired? To answer this question, consider what Goodwin (1994) refers to as *professional vision*. According to Goodwin, as people become part of a professional discipline they develop particular ways of viewing the phenomena that are of interest to their professional group. Thus, archeologists develop techniques for looking at stones and sand, and detectives are good at noticing things that stand out at a crime scene. Similarly, teachers have professional vision—the ability to see and interpret critical features of classroom events (Sherin, 2001). Other researchers adopt a similar perspective, noting that one kind of teaching expertise involves the ability to "see" what is happening in a classroom (Berliner, 1994; Frederiksen, 1992; van Es & Sherin, 2002). In sum, we claim that the learning that occurred in the video club can be characterized as the development of teachers' professional vision. The teachers learned to attend to particular kinds of events that happen in a classroom and they learned to reason about these events in particular ways.

In the future, we believe that many interesting questions regarding teacher learning, particularly in video clubs, can be framed in terms of the development of professional vision. For example, we can ask how "noticing" and "reasoning" about classroom events interact in the context of video clubs. On the one hand, what the teachers noticed

appeared to influence the reasoning that took place. Specifically, once the teachers began to focus on student conceptions, they developed sophisticated techniques for analyzing the student ideas that stood out to them. Yet in addition, these new techniques may have influenced what the teachers perceived to be important in the video excerpts. For instance, their new approach to examining student thinking may have prompted the teachers to look for different kinds of pedagogical issues to discuss.

Finally, we wish to comment on the role of the video in the learning that has been described here. We believe that video served as an important catalyst for learning by providing teachers with a new kind of access to classroom interactions. In other work, we elaborate on the unique affordances that video has to offer teacher education (Sherin, 2004). For example, video provides a lasting record of instruction that can be examined repeatedly without the immediate pressures of teaching. However, as others have also argued (e.g., Little, 2002), it is only through the use of video in particular professional development contexts that this potential can be realized. For the video clubs described in this article, we suspect that a number of features were of particular importance including the specific types of video excerpts that were selected for viewing, the facilitator's role and initial focus on student conceptions, and the interactions among the video club participants. Additional research is needed to explore how different aspects of the video club environment influenced and supported the learning that occurred.

Furthermore, in this case, as mentioned earlier, only two of the four teachers chose to show video excerpts from their classrooms in the meetings. This raises the question of whether teachers can learn as much from viewing video exclusively of other teachers as they would from viewing video of their own classes. While this issue was not the focus of the current study, there are indications in our data to suggest that participation and learning in the video club did not differ among those teachers whose video was and was not shown. Moreover, in individual interviews following the final video club meeting, all four teachers emphasized that they learned from participating in the video clubs, and in particular, that they learned to pay more attention to students' ideas both when watching video and during instruction. Another related question concerns the development of teacher community and the effect of having only some members of the community agree to be videotaped. We suspect that in the video clubs described here, the teachers' ability to work together to make sense of the video excerpts was mediated by the fact that the teachers all taught at the same school, used common curriculum materials, and were familiar with many of the students who were viewed on the videotapes. Thus while only a subset of the teachers volunteered to be videotaped, other shared aspects of practice appeared to allow all members to participate equally within the group.

6. Conclusions and implications

This paper examines what teachers learn as they participate in a series of video club meetings. Two main results have been discussed. First, there were changes in *what* the teachers discussed in the video clubs. Initially, the teachers raised pedagogical issues for the group to consider. Later, the teachers began to also focus on issues concerning student conceptions. Second, there were changes in *how* the teachers discussed both of these topics. Over the course of the video clubs, the teachers selected more complex issues related to student conceptions to examine. In terms of pedagogy, there was an initial tendency for the teachers to suggest alternative strategies for the teacher on the video. Later, however, it was more common for the teachers to try to understand the teaching strategy that was used. In addition, the teachers began to connect their analyses of pedagogical issues with their ideas about student thinking.

6.1. Supporting the implementation of mathematics education reform

These changes are particularly important given the goals of mathematics education reform in the United States. Specifically, the teachers began to

notice features of classroom interactions that are believed to be important in light of current reform efforts, and furthermore, they began to reason about these features in ways that can help teachers meet the demands of reform.

First, one change involved an increased emphasis on the part of the teachers to examine student thinking. Prior research suggests that increased attention to students is an important component of developing expertise as a teacher (Carter, Cushing, Sabers, Stein, & Berliner, 1988; Fuller & Brown, 1975). In addition, recent research finds that a focus on student thinking is particularly critical for the successful implementation of mathematics education reform (e.g., NCTM, 2000). For example, Fennema et al. (1996) found that once teachers became aware of the ways that students understood addition and subtraction word problem, they became better able to support students' learning in this area. Similarly, Ball (1993, 1997) claims that teachers need to learn to respect children's thinking and to try to make sense of students' mathematical understandings. Thus, teachers' ability to interpret students' ideas is thought to be a key component of improving the teaching and learning of mathematics. And through participating in the video club, the teachers learned to engage in such analysis. It remains to be seen, however, how conducting such analysis in the video club might influence the teachers' actual instruction. While we have not yet examined this issue systematically, in interviews following the final video club, each of the teachers claimed that they now paid more attention to student thinking during instruction than they had prior to participating in the video club.

A second change concerned the teachers' interest in exploring pedagogical issues. Rather than suggest alternative pedagogical strategies that might have been used, the teachers came to try to understand what did happen. This change reflects what other researchers have described as a view of teaching as inquiry (Ball, 1993) and discovery (Hammer, 1997). Moreover, this perspective emphasizes the need for teachers to closely analyze their teaching practices and argues that it is when teaching becomes learning for the teacher that the implementation of reform can be effective (Sherin, 2002).

Third, the teachers came to view issues related to pedagogy and student thinking as connected; they examined their roles as teachers in light of how students were exploring mathematical ideas. Franke, Carpenter, Levi, and Fennema (2001) suggest that this connection between pedagogy and student thinking is a powerful mechanism for sustaining reform and for generative change on the part of teachers. Specifically, they found that those teachers who not only wanted to listen to students' ideas, but who expected to learn from what students said and to consider their teaching in light of those ideas had the most success in implementing mathematics education reform.

Investigating new forms of professional development that can support the implementation of reform is a central goal of reform efforts. This paper suggests that video clubs have that potential. Video clubs provide a context in which teachers can reflect on their teaching and can learn new ways to understand both teaching and learning.

Acknowledgements

An earlier version of this paper was presented at the Annual Meeting of the American Educational Research Association, April, 2002. This research was supported by a post-doctoral fellowship from the National Academy of Education/Spencer Foundation to the first author and by the National Science Foundation under Grant No. 0133900. Additional support was received from the Andrew W. Mellon Foundation for a grant to Lee S. Shulman and Judith Shulman for the Fostering a Community of Teachers as Learners Project. The opinions expressed are those of the authors and do not necessarily reflect the views of the supporting agencies. The authors wish to thank Scott MacKenzie, Bruce Sherin, Margaret Smith, and two anonymous reviewers for their thoughtful comments, and Gabrielle Matese and Rebekah Wrobbel for their research assistance. The authors are grateful to the teachers who participated in the video clubs as well as to our collaborators Edith Prentice Mendez and David Louis.

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