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Chapter 24
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The Development of Teachers' Professional Vision in Video Clubs

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What is it that enables the archeologist to see a collection of stones as part of a larger structure that once existed? Why is it that a meteorologist can look at the sky and recognize patterns in the shape and coloring of clouds? Goodwin (1994) provides one answer by introducing the notion of professional vision. As Goodwin explains, professional vision involves "socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group," (p. 606). In other words, members of a professional group develop specific ways to interpret the phenomena that are the focus of their work.

This chapter is concerned with teachers' professional vision (Sherin, 2001). Although professional vision is only one component of teaching expertise, it is of particular importance today in light of the demands that mathematics education reform places on teachers. Traditionally, the structure of a mathematics lesson was determined by the teacher prior to instruction. Reform efforts, however, call for teachers to base their instruction, at least in part, on the lesson as it unfolds in the classroom with close attention given to the ideas that students raise (National Council of Teachers of Mathematics, 2000; Smith, 1996). Thus, teachers need to be able to "see" how a lesson is going and to interpret students' ideas in the midst of instruction. Even veteran teachers who are already skilled at interpreting classroom events may need to develop a new kind of professional vision. That is, they may need to learn to see different kinds of events and in different ways. An important challenge then, is to provide teachers with experiences in which they can develop this new kind of professional vision.

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In this chapter, I examine the development of professional vision as teachers participate in a professional development program called video clubs. In video clubs, groups of teachers watch and discuss excerpts of videos from their classrooms. In many ways, the use of video may seem like an obvious choice for helping teachers to develop professional vision. Video appears to be able to capture much of the richness of classroom interactions and it can be used in contexts that allow teachers time to reflect on these interactions. Yet despite a wealth of video-based professional development programs, there is little empirical evidence to support the claim that viewing videotapes of classroom instruction can be an effective context for teacher learning (Fuller & Manning, 1973; McIntyre, Byrd, & Foxx, 1996; Sherin, 2004). As a result, the goals of this research are two-fold. First, I want to propose that professional vision offers a productive way to conceptualize what it means to examine the role of video in teacher learning. Second, I want to explore the ways in which participating in video clubs can support the development of teachers' professional vision.

In the remainder of this chapter, I first define more explicitly what it means for teachers to have professional vision. I then describe the results of a year-long study in which four middle-school mathematics teachers participated in monthly video club meetings with a facilitator.

WHAT DOES IT MEAN FOR TEACHERS TO HAVE PROFESSIONAL VISION?

Unlike archeologists who examine stones and sand, the phenomena that are of interest to teachers are classroom events. Thus, for teachers, professional vision involves the ability to make sense of what is happening in their classrooms. And like all perceptual processes, professional vision is not a simple passive observation of the world. Instead, it involves a dynamic interplay of top-down and bottom-up processes. As a teacher observes a classroom, he or she is constantly reasoning about what is seen, and this drives where and how the teacher will look in the future. Although this dynamic interplay is complex, here I simplify somewhat and describe professional vision as consisting of two distinct subprocesses; (a) selective attention, and (b) knowledge-based reasoning.

Classrooms are complex environments, with much happening simultaneously. A teacher cannot pay attention to everything with equal weight; instead certain things will stand out to the teacher. It is this process that I refer to as selective attention. For instance, a teacher's attention may be drawn to the mathematical ideas that are being discussed in class. Alternatively, a teacher may focus on the ways in which students interact with each other—who is speaking to whom and in what manner. In still another case, a teacher may pay particular attention to the level of noise in the classroom as a way of keeping track of how a lesson is proceeding. In each of these examples, the teacher's attention is tuned to particular kinds of events that take place in the classroom.

Other researchers describe related phenomena. Specifically, Frederiksen (1992) defines the notion of a "call-out" in which teachers literally call out what appears noteworthy to them in a videotaped mathematics lesson. Similarly, Jacobs and Morita

(2002) describe "stopping points" in which a teacher pauses a videotape of a mathematics lesson in order to comment on the instruction. Finally, van Es and Sherin (2002) use the term "noticing" to describe the process through which a teacher identifies what is important in a classroom episode. Common to all of these is the idea that as a teacher views instruction, whether live or via video, certain aspects of the classroom interactions receive more attention from the teacher than do others.

The second process is what I refer to as knowledge-based reasoning. The idea is that once the teacher's attention is drawn to a particular event, next the teacher will begin to reason about that event based on his or her knowledge and understanding. Some examples of this reasoning process that are particularly important for teachers are described in van Es and Sherin (2002). These include using what one knows about the subject matter to make sense of an idea that has been raised, using what one knows about the classroom context to understand why a person spoke or acted in a particular way, and making connections between the specifics of the classroom and broader principles of teaching and learning.

Although I have suggested here that a teacher will first notice a classroom event and will then begin to reason about it, the situation is, in practice, much more complicated. To reiterate, selective attention and knowledge-based reasoning interact in a dynamic manner. On the one hand, what stands out to a teacher will certainly influence the reasoning that takes place. But in addition, a teacher's expectations and knowledge also drive what a teacher perceives.

In this chapter, I examine the development of teachers' professional vision by looking at changes in each of these processes as teachers participated in a series of video club meetings. Specifically, I argue that, over time, there was a shift in the teachers' selective attention as they began to focus on different kinds of events that were visible in the video excerpts. In addition, I claim that the teachers developed new techniques for reasoning about the phenomena that they viewed on video. I will also briefly consider the interaction between these two processes.

RESEARCH DESIGN

Four middle-school mathematics teachers participated in a monthly video club with a facilitator across one school year. All of the teachers taught at the same public school outside a large U.S. city. The group of teachers included one female and three male teachers, and their teaching experience ranged from 1 to 28 years.

The video clubs took place after school once a month for approximately 40 min each. Prior to each meeting, the facilitator videotaped in one of the teacher's classroom and later met with that teacher to review potential excerpts to show in the video club. The selected video excerpts were generally from whole-class discussions and lasted between 5 and 7 min. At the beginning of each meeting, the teacher whose video was being viewed provided background information on the lesson that appeared in the video. Transcripts of the excerpt along with any handouts used in class were then passed out to the participants and the video was played. After viewing the video excerpt, the facilitator typically began by asking the teachers "What did you notice?" or "Any comments?"

In all, seven video club meetings took place across the school year.[1] Each of these meetings was videotaped and transcribed. The teachers also participated in an individual interview following the final meeting in which they discussed their experiences in the video clubs.

Data Analysis

Data analysis consisted of two main components. First, to examine to what the teachers attended in the video, I chose to focus on the topics that they raised for discussion. Clearly, topic alone does not come close to capturing all of the complexity that is involved in teachers' selective attention. Nonetheless, I felt that topic could serve as a useful indicator of changes occurring to the teachers' selective attention.

To study the topics raised, two researchers independently examined the transcripts of the video clubs and noted where there was a change in the topic of conversation. This process is similar to what Jacobs and Morita (2002) describe as dividing up a transcript into "idea units." Initial agreement among the researchers on the resulting discussion segments was 90.8%. Points of disagreement were then reviewed together and consensus was reached.

Next, select segments from each of the video club meetings were used to identify the different topics that were discussed by the teachers. Five topics were identified; (a) pedagogy, (b) student conceptions, (c) classroom discourse, (d) mathematics, and (e) other. Segments relating to pedagogy concern what the teacher in the video is doing and saying. Segments about student conceptions concern what the students understand about mathematics in a lesson. The third category, classroom discourse, has to do with the ways that the teacher and students talk with each other during class, that is, how many students participate in a discussion or whether students' comments are directed to the teacher or to other students. Next, mathematics involves the teachers' own ideas about the mathematics in a lesson. The final category, other, includes comments that do not fit into any of other four categories, for instance, comments about technical aspects of the video that was viewed.

Using these five categories, the researchers coded the discussion segments that had been identified previously. This involved independently assigning one of the five categories to each segment. Initial agreement among the researchers was 86.6%. After reviewing the points of disagreement, consensus was reached on all segments. Following this, the amount of time spent discussing each topic in the different video club meetings was calculated. It was also noted whether each segment was initiated by one of the teachers or by the facilitator.

The second component of analysis focused on the ways in which the teachers reasoned about what they noticed in the video. Again, I did not try to capture all of the complexity involved in teachers' knowledge-based reasoning. Instead, I focused on the ways in which the teachers reasoned about the two topics that were discussed most

[1]The group actually met 10 times during the school year, although the final three meetings had a different format than the initial seven video club meetings.

frequently in the video clubs, student conceptions (42% of the total time) and pedagogy (35% of the total time). Specifically, all discussion segments related to these two topics were examined for differences in the ways that the teachers approached these topics over time.

RESULTS

During the course of the video clubs, the teachers' professional vision developed in important and interesting ways. First, in terms of selective attention, the teachers began to pay attention to new aspects of classroom events. Second, with respect to knowledge-based reasoning, the teachers developed new techniques for thinking about what they noticed. In addition, the data provides evidence of the complex relationship between these two processes, specifically, that changes in selective attention influenced the teachers' knowledge-based reasoning and vice versa.

The Development of Selective Attention

There are many ways in which a teacher could begin to attend to different aspects of classroom events. Here, I examine this issue by investigating the topics that the teachers raised for discussion across the seven video clubs. As described in Sherin and Han (2004), in the first video club meeting, the comments raised by the teachers focused primarily on pedagogical issues—on what the teacher in the video was doing. For example, the teacher whose video was shown to the group asked if he had made the right decision by discussing a particular issue with the class. "What I wanted to [ask] was, how do you decide? [Because] you know, as teachers you make decisions right on the spot about explore it or don't explore it." Later another participant asked about the goals of the teacher in the video. "Did you actually have a plan or did you want to [see what would happen]?"

In contrast, in the seventh video club, the teachers' comments focused much less on pedagogy. Instead, the teachers appeared to be primarily concerned with issues relating to student conceptions—to what the students in the video understood about the mathematical ideas raised in class. Specifically, early in this video club, one of the teachers mentioned different approaches that students seemed to be using to examine two related sets of data. "A lot of them were comparing the [data sets] instead of just looking at one list of numbers." This prompted a lengthy discussion concerning which of the two data sets appeared to be most relevant to students and whether students were "looking at the relationship between the two lists." The teachers also initiated an extended discussion of one student's thinking, trying to make sense of what this student, Brenda, understood about the data presented. Later, the teachers considered the different kinds of comments students made relating to the idea of correlation. "[Are students talking about] the difference between correlation and cause and effect?" Finally, prior to the conclusion of the video club, one of the teachers raised a pedagogical issue, asking about the teacher's goals for the lesson and whether the ways in which the students had discussed the data aligned with what the teacher hoped to achieve in class that day.

The teachers' attention in these two video clubs was drawn to very different kinds of events. In the first video club, the teachers were mainly concerned with what the teacher in the video was doing and saying. To be clear, there was some discussion of student conceptions during the first video club, but it was almost exclusively the facilitator who raised the topic. On the contrary, in the seventh video club, the teachers themselves initiated a great deal of discussion about student conceptions, and the facilitator played a much more minor role.[2] Issues of pedagogy were still of interest to the teachers, but in addition, what the students were doing and saying about mathematics had become more visible to the teachers—their selective attention had become attuned to an additional topic.

This pattern of increasing attention to student conceptions over time was confirmed through a detailed analysis of all seven video club meetings. Table 24.1 summarizes some of what was found. Specifically, Table 24.1 shows the percent of teacher-initiated segments of conversation by topic across the seven video clubs. First, note that student conceptions and pedagogy were in fact the two most commonly raised topics by the teacher.[3] Second, looking at the data for these two topics illustrates that while pedagogy remained an important focus of attention for teachers throughout the video clubs, the teachers also began to generate discussions of student conceptions. Specifically, in video club meetings 1 and 3, less than 15% of the issues raised by the teachers concerned student conceptions and 50% or more related to pedagogy.[4] In video clubs 4, 5, and 6, student conceptions were raised, on average, 40% of the time, whereas pedagogical issues were brought up 36% of the time. In the final meeting, video club 7, the teachers initiated discussion of student conceptions 86% of the time, whereas pedagogical issues were raised only once, 14% of the time. It is not clear whether video club 7 is representative of a trend that would have continued had there been additional video clubs meetings. Nonetheless, the data suggest that the teachers came to pay greater attention to student conceptions over the course of the video clubs.[5]

To be clear, on its own, the data presented in Table 24.1 are not intended to establish, with any confidence, changes in the selective attention of teachers. My primary argument for changes in selective attention relies on the detailed qualitative

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[2]In video club 1 the facilitator initiated 89% of the discussion segments related to student conceptions. In video club 7, the facilitator initiated only 25% of the discussion segments related to student conceptions. In general, the facilitator's participation in the video clubs decreased over time.

[3]Segments coded as other comprised only 4% of the teacher-initiated discussion segments and are not included in Table 24.1.

[4]Video club 2 is somewhat of an anomaly in that the teachers initiated almost twice as many discussion segments overall than in video clubs 1 and 3, and more of these segments concerned student conceptions than pedagogy. I believe, however, that in video club 2, the teachers' goal was simply to raise a variety of issues for discussion and that they were less concerned at this point with whether or not an issue raised was particulary noteworthy. In fact seven of the fifteen discussion segments initiated by the teachers in video club 2 were discussed for less than 20 seconds. This included three of the five segments concerning student conceptions.

[5]Here the unit of analysis is the group of teachers. Although not the focus of the current study, there are indications in the data to suggest that the trends reported here hold across the individual teachers as well.

TABLE 24.1
Percent (and Number) of Teacher-Initiated Segments of Discussion Per Topic ⏎

	Video Club 1	*Video Club 2*	*Video Club 3*	*Video Club 4*	*Video Club 5*	*Video Club 6*	*Video Club 7*
Student Conceptions	14%(1)	33%(5)	13%(1)	50%(4)	40%(4)	30%(3)	86%(6)
Pedagogy	57%(4)	27%(4)	50%(4)	38%(3)	30%(3)	40%(4)	14%(1)
Discourse	14%(1)	27%(4)	25%(2)	13%(1)	10%(1)	20%(2)	0%(0)
Mathematics	14%(1)	13%(2)	13%(1)	0%(0)	20%(2)	10%(1)	0%(0)

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

analysis described in Sherin and Han (2004). Table 24.1 is intended only to provide a summary for the reader of what was observed, and to point to the plausibility of my overall conclusions.

The Development of Knowledge-Based Reasoning

In using the phrase knowledge-based reasoning, I mean to encompass a broad range of cognitive processes. In this section, however, I focus on the teachers' reasoning about issues related to student conceptions. As stated previously, over the course of the video clubs, the teachers began to raise issues of student conceptions with increasing frequency. Here I make a different claim—that the teachers developed new ways to reason about student conceptions.

As described in Sherin and Han (2004), when exploring student conceptions, the teachers engaged in three different levels of analysis, each representing an increasingly complex way to explore the ideas that students raised in the video. First, comments at Level 1 generally involved simply reading what a student had said directly from the transcript of the video. For example, in video club 1 the facilitator asked the teachers what the students had said about a particular graph and the teachers responded by listing statements from the transcript. "[Amy] says 'It's not very realistic." "Ben says, 'I goofed.'" At Level 2, the teachers' comments involved beginning to analyze students' ideas. Thus, they went beyond simply restating what a student had said and tried to make sense of the meaning of a students' comment or method. For example, in video club 3, the teachers tried to understand what one student meant when she said that a line was "straighter" and that a straight line is "like a 90 degree angle." Level 3 comments consisted of generalization and synthesis of the students' ideas. At this level, the teachers looked at connections across the ideas of several students, or at how a specific idea related to other mathematical concepts that had been explored by the students in the video. An example of Level 3 analysis occurred during video club 7 when the teachers discussed the issue of correlation, and tried to understand the different ways that students addressed this issue in the video.

Although over time the teachers examined student conceptions at all three levels, in the early video club meetings the teachers engaged heavily in Level 1 analysis. In addition, during the first video club, there were two occasions in which the teachers did not follow up on the facilitator's suggestion that they consider issues related to student thinking. Instead, the teachers proceeded to change the topic of discussion. Beginning with video club 4, however, the teachers began primarily to discuss student conceptions at Level 2. Table 24.2 illustrates this pattern by indicating the highest level of analysis achieved for each discussion segment that was coded as relating to student conceptions.

To be clear, there were instances early on in which the teachers engaged in Level 2 and Level 3 analyses. However, these were heavily scaffolded by the facilitator. In contrast, in the later video clubs, the facilitator played a less central role and the level of analysis was determined instead by the participating teachers. I return to this issue of the decreasing influence of the facilitator in the next section of this chapter.

Thus, during the course of the video clubs, the teachers came to think about issues of student conceptions in new ways. Yet, these changes raise questions concerning what was actually learned by the teachers. Are we seeing deep changes in the reasoning that the teachers were capable of doing? Or are these changes representative merely of changes in inclination or in how the teachers saw the task as presented by the facilitator in the video club? To make progress on these questions, I believe that it is necessary to look at the interaction between selective attention and knowledge-based reasoning.

Exploring the Relationship Between Selective Attention and Knowledge-Based Reasoning

Thus far, I have examined the development of teachers' selective attention and knowledge-based reasoning independently, and have pointed to possible changes in

TABLE 24.2
Teachers' Analysis of Student Conceptions ⏎

Discussion segments concerning student conceptions	*Video Club 1*	*Video Club 2*	*Video Club 3*	*Video Club 4*	*Video Club 5*	*Video Club 6*	*Video Club 7*
No response to facilitator's prompt to discuss student ideas	2	0	0	0	0	0	0
Level 1: Teachers quote student statements	4	4	2	1	0	1	0
Level 2: Teachers explore meaning of student statements	1	3	1	4	4	1	4
Level 3: Teachers synthesize student ideas	2	1	1	1	1	1	4

each of these areas. Yet as described earlier, in practice, there exists a dynamic relationship between these two processes. Here I examine this interaction at two time scales.

Interactions Between Selective Attention and Knowledge-Based Reasoning at a Broad Time Scale. I first consider the interaction between selective attention and knowledge-based reasoning at a broad time scale. Across the hours and weeks during which the teachers participated in the video clubs, their new focus on student conceptions prompted the development of new reasoning processes in two ways. First, as described already, paying more attention to events related to student conceptions drove the development of increasingly sophisticated strategies for reasoning about student conceptions. Second, this new focus on student conceptions also influenced how the teachers reasoned about pedagogical issues.

When the teachers discussed pedagogical issues, they tended either to explore alternative pedagogical strategies that the teacher in the video might have used or to offer explanations for why the teacher in the video used a particular approach. In either case, student thinking was initially not a factor in trying to understand the teachers' actions. Later however, discussions of pedagogical issues were closely tied to student thinking (Table 24.3). Consider, for example, the pedagogical issue that came up at the end of video club 7. The group's discussion of whether the teacher's goals for the lesson had been achieved was based heavily on what the group had come to recognize concerning student understanding of the data. For instance, the teacher whose video was viewed explained that he "wasn't asking [students] to decide if they thought there was [a] correlation" and that having students raise a variety of ideas about the data matched his goals for the day. This stands in sharp contrast to the group's discussion, during video club 1, of the teacher's goals for the lesson. In that case, the group focused on the teacher's plan independent of students and asked specifically about the teacher's decision to introduce the lesson in a particular way.

In sum, I claim that the teachers' increased attention to student conceptions had a powerful influence on the way that they reasoned about what they noticed. Not only did the teachers develop new techniques for analyzing student thinking, they also began to reason about pedagogical issues in terms of student conceptions. Moreover, I suggest that these developments in the teachers' knowledge-based reasoning ultimately influenced their selective attention. To explain this, consider once again the different levels at which the teachers engaged in discussions of student conceptions.

TABLE 24.3
Connecting Issues of Pedagogy and Student Thinking ⏎

Teacher-Initiated Discussion Segments Concerning Pedagogy	*Video Club 1*	*Video Club 2*	*Video Club 3*	*Video Club 4*	*Video Club 5*	*Video Club 6*	*Video Club 7*
Discussed independent of student thinking	4	4	4	1	0	0	0
Discussed in light of student thinking	0	0	0	2	3	4	1

Table 24.4 is similar to Table 24.2 except that it distinguishes between those discussion segments that were initiated by the teachers and those that were initiated by the facilitator. What I want to point out is that in video clubs 1–3, all Level 3 analysis involved discussion segments that were initiated by the facilitator. Thus, it was the facilitator who selected the issues to be analyzed at this complex level. Beginning in video club 4, however, the teachers initiated discussion segments that involved Level 3 analysis. Therefore, in addition to my earlier claim that the teachers began to reason about student thinking in more complex ways over time, here I argue that they also began to "see" more complex issues concerning student thinking in the video excerpts—that what they noticed about student thinking in the video was itself more complex as a result of their experiences in reasoning about these types of events.

Interactions Between Selective Attention and Knowledge-Based Reasoning at a Narrow Time Scale. Selective attention and knowledge-based reasoning also interact at a much more narrow time scale. Within a single "discussion segment," the teachers were likely to engage in several cycles of attending to and reasoning about an event. If our goal is to understand the development of professional vision, then it is critical to examine the interaction at this level. A teacher may be able to learn to "see" something interesting or to engage in a certain kind of analysis, but being able to use these processes fluidly and in support of each other indicates an important level of attainment in the development of professional vision. Here I present one example of this kind of interaction taken from video club 7.

As described briefly earlier in this chapter, in video club 7, the teachers viewed a video clip in which students were examining the relationship between two sets of data. After discussing some of the different ways in which the students were exploring the data, one of the teachers asked "What is Brenda talking about?" Given what Brenda had said, the teacher was unsure whether Brenda was analyzing only one or both sets of data. The teachers then worked together to understand the meaning of Brenda's idea,

TABLE 24.4
Comparison of Teacher- and Facilitator-Initiated Analyses of Student Thinking ⏎

		Video Club 1	*Video Club 2*	*Video Club 3*	*Video Club 4*	*Video Club 5*	*Video Club 6*	*Video Club 7*
Teacher-initiated segments	Level 1	1	3	0	0	0	1	0
	Level 2	0	2	1	3	3	1	3
	Level 3	0	0	0	1	1	1	3
Facilitator-initiated segments	No response	2	0	0	0	0	0	0
	Level 1	3	1	2	1	0	0	0
	Level 2	1	1	0	1	1	0	1
	Level 3	2	1	1	0	0	0	1
Total		9	8	4	6	5	3	8

paying particular attention to Brenda's claim that "there's a medium correlation." The teachers discussed the meaning of the term correlation and what Brenda might understand about this idea. They then came up with two different ideas for what Brenda might have been trying to say. One idea was that Brenda was looking at a single set of data and was informally correlating the data to the order of the numbers. A second idea was that Brenda was in fact considering both sets of data and "realizes that the numbers … in the left column are going up … [but] she sees some inconsistency." Unable to reach consensus, the teachers decided to watch more of the video from the class. They did so, paying close attention to Brenda's participation. Using this new information, the teachers continued their discussion of Brenda's idea, finally coming to consensus concerning the idea that she had been trying to share in class.

This example illustrates a complex interaction between selective attention and knowledge-based reasoning. First, selective attention is at the fore as one of the teachers noticed that what Brenda said did not make sense to him and he raised this issue with the group. In response, the group as a whole examined Brenda's statements and tried to understand their meaning—they drew on their knowledge-based reasoning skills to make sense of Brenda's ideas. In doing so, the group pointed to Brenda's use of the term "medium correlation" as particularly important. Thus, in the midst of their reasoning about Brenda's ideas, selective attention was still in play as they chose which part of Brenda's statement required special attention. With this in mind, the teachers reasoned further about Brenda's idea but were unable to come to consensus. At this point, the teachers turned once again to selective attention, looking for more information about Brenda's thinking. Based on what they now noticed, the teachers reasoned additionally and were able to come to consensus.

I now return to my question concerning the depth of the changes that occurred in the teachers' attention to and reasoning about student conceptions. Although I believe that the changes described earlier in this chapter are impressive and nontrivial, the extended interactions of the type that I describe earlier are more indicative of deep change. Thus, I suspect that at some level, it may be a rather simple matter to get teachers to, in some cases, attend to and reason about student conceptions. In contrast, it will turn out to be much more difficult, through professional development, to have teachers engage in the sort of extended reasoning illustrated earlier. Firmly establishing this hypothesis is a matter for future work.

CONCLUSIONS AND IMPLICATIONS

In this chapter, I have tried to show that while participating in a series of video clubs, teachers developed professional vision. In particular, they began to pay close attention to student thinking and began to reason about what they noticed in new ways. Furthermore, these processes interacted in powerful ways as teachers tried to make sense of what they viewed on the video. The teachers learned through their participation in the video clubs—and learned in ways that are likely to help support their efforts to implement mathematics education reform. As described in prior research, a focus on student thinking is critical to the successful implementation of reform (Ball, 1997; Fennema et al., 1996; Sherin, 2002) and connecting ideas about pedagogy with stu-

dent thinking is also a powerful component of reform-based instruction (Franke, Carpenter, Levi, & Fennema, 2001).

What I have presented here is more than a story of teacher learning. In introducing the notion of teachers' professional vision, I have extended current approaches for conceptualizing teacher cognition. In addition, this research establishes the importance of examining professional vision, in particular, in order to better understand the affordances of video for teacher education. Finally, if we agree that the development of teachers' professional vision is an important goal, then this research suggests that we pay close attention to the design and implementation of video-based professional development, for such contexts may be uniquely situated to helping develop teachers' professional vision.

Many questions remain to be answered in future work, two of which I mention here. First, what is the relationship between teachers' professional vision as it is used in video clubs and teachers' professional vision during instruction? In other words, how do changes in professional vision that occur in a video club influence teachers' instructional practices? Second, how might video clubs be designed to support the development of professional vision in particular ways? Here I claimed that teachers learned as a result of participating in a series of video clubs, but I did not look closely at the design of the video clubs themselves. For example, how did the facilitator's role influence the learning that took place? How did the particular video clips influence what teachers were able to "see?"

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REFERENCES

Ball, D. (1997). From the general to the particular: Knowing our own students as learners of mathematics. *The Mathematics Teacher, 90*(9), 732–737.

Fennema, E., Carpenter, T. P., Franke, M. L., Levi, L., Jacobs, V. R., & Empson, S. B. (1996). A longitudinal study of learning to use children's thinking in mathematics instruction. *Journal for Research in Mathematics Education, 27*, 458–477.

Franke, M. L., Carpenter, T. P., Levi, L., & Fennema, E. (2001). Capturing teachers' generative change: A follow-up study of professional development in mathematics. *American Educational Research Journal, 38*(3), 653–689.

Frederiksen, J. R. (1992, April). *Learning to "see": Scoring video portfolios or "beyond the hunter-gatherer in performance assessment.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Fuller, F. F., & Manning, B. A. (1973). Self-confrontation reviewed: A conceptualization for video playback in teacher education. *Review of Educational Research, 43*(4), 469–528.

Goodwin, C. (1994). Professional vision. *American Anthropologist, 96,* 606–633.

Jacobs, J. K., & Morita, E. (2002). Japanese and American teachers' evaluations of videotaped mathematics lessons. *Journal for Research in Mathematics Education, 33*(3), 154–175.

McIntyre, D. J., Byrd, D. M., & Foxx, S. M. (1996). Field and laboratory experiences. In J. Sikula (Ed.), *Handbook of research on teacher education* (pp. 171–193). New York: Simon & Schuster.

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

Sherin, M. G. (2001). Developing a professional vision of classroom events. In T. Wood, B. S. Nelson, & J. Warfield (Eds.), *Beyond classical pedagogy: Teaching elementary school mathematics* (pp. 75–93). Mahwah, NJ: Lawrence Erlbaum Associates.

Sherin, M. G. (2002). When teaching becomes learning. *Cognition and Instruction, 20*(2), 119–150.

Sherin, M. G. (2004). New perspectives on the role of video in teacher education. In J. Brophy (Ed.), *Using video in teacher education* (pp. 1–27). New York: Elsevier.

Sherin, M. G., & Han, S. (2004). Teacher learning in the context of a video club. *Teaching and Teacher Education, 20,* 163–183.

Smith, J. P. (1996). Efficacy and teaching mathematics by telling: A challenge for reform. *Journal for Research in Mathematics Education, 27*(4), 458–477.

van Es, E. A., & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of Technology and Teacher Education, 10*(4), 571–596.