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ACCESSING MATHEMATICS TEACHERS' IN-THE-MOMENT NOTICING¹

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The mathematics classroom is a complex environment in which multiple things happen simultaneously. Teachers cannot possibly attend to all this richness equally; they must learn to filter through that complexity and decide where to place their instructional attention and efforts. A crucial part of teaching, then, involves observing the classroom and choosing and making sense of those aspects of the class that are pedagogically relevant. This book as a whole and the individual chapters within it are all predicated on the belief that this process—what has been called *noticing*—is a key component of teaching expertise and of mathematics teaching expertise in particular.

In our own work studying teacher noticing, we have had countless conversations with teachers about the kinds of things they pay attention to in class. Consider, for example, the following description that one high school teacher, Mark, gave us for how he decides what to notice and focus on during instruction:

Mark: I think it's almost a physical reaction. Where it's like . . . as a teacher I'm listening; I'm listening, and I'm sort of . . . just tracking the conversation. And then, like literally, physically, like, sort of, “wow,” like something like pricks my senses.

Mark's noticing seems to rely largely on some tacit intuitions; if asked why certain things “pricked his senses” and others did not, he might be unable to articulate the reason. Instead, it is just a feeling he gets when he knows that something important is taking place.

Contrast Mark's description of his noticing with that of another teacher, Sean:

Sean: So I guess I wanted to find moments where students were figuring something out . . . and I was looking for those moments where they were . . .

they were kind of confused, going from being confused to, to understanding, either with my help or the help of . . . a classmate.

Sean said that, on this day in class, he had found himself on the lookout for a particular kind of moment. Unlike Mark, who did not describe being tuned a priori to any specific aspect of class, Sean articulated that he was specifically interested in those times when students were moving from confusion to understanding.

Although we find Mark's and Sean's comments quite interesting, we wonder how accurate their descriptions are. Mark and Sean tell us how they *think* they notice, but is that really how it happens? What we as researchers interested in understanding teacher noticing would ideally like is a way to get more directly at teachers' noticing in the moment—a way to access the process of noticing while it is occurring.

In what follows, we first draw on recent conceptualizations of mathematics teacher noticing to articulate the approach we take in this chapter. Next we describe three types of research methodologies that have been used to investigate teacher noticing and the strengths and limitations of each approach for accessing that noticing. We then explain our use of a new video technology that we believe provides greater access to teachers' in-the-moment noticing than has been available before. Finally, we discuss what we have learned about accessing teacher noticing through our ongoing work with this new technology.

Current Conceptualizations of Teacher Noticing

Researchers interested in understanding mathematics teacher noticing conceptualize the phenomenon they are studying—the *noticing*—in a variety of ways. That is, different researchers include different aspects of a teacher's thinking and practice in their definitions of *noticing*.

Some researchers understand noticing as involving only the process in which teachers initially see, or perceive, different aspects of classroom activity. For example, Star and Strickland (2008) and Star, Lynch, and Perova (this volume, chapter 8) examined “what catches their [the teachers'] attention, and what they miss . . . when they view a classroom lesson” (Star & Strickland, 2008, p. 111). This approach to teacher noticing, then, involves exploring what a teacher attends to as well as what a teacher decides not to attend to. (See Miller, this volume, chapter 4, for additional discussion of how and why teachers focus on some events and filter out others.)

Other researchers are interested not only in this initial filtering of classroom activity but also in teachers' interpretations of that activity. This is the stance that we have generally taken in prior research (e.g., Colestock & Sherin, 2009; M. G. Sherin, 2007; M. G. Sherin & van Es, 2009). Specifically, we have focused on noticing as *professional vision* in which teachers selectively attend to events that take place and then draw on their existing knowledge to interpret these noticed

events. For example, teacher noticing would include not only a teacher's paying attention to a particular student idea but also the teacher's making sense of that idea on the basis of his or her knowledge of that student and the mathematics content. Our assumption is that a teacher's expectations and knowledge influence how the teacher perceives events that take place in the classroom. Thus understanding a teacher's noticing must also involve understanding how a teacher interprets what he or she perceives.

Finally, Jacobs and her colleagues (Jacobs, Lamb, & Philipp, 2010; Jacobs, Lamb, Philipp, & Schappelle, this volume, chapter 7) take an even more inclusive view of teacher noticing. They defined *professional noticing* as involving not only teachers' attention to and interpretation of classroom activity but also teachers' plans to respond to that activity. They explained that including *intended responding* in their characterization of noticing reflects the idea that all three processes are tied together conceptually and temporally.

Each of these definitions of *noticing* localizes the phenomenon to be studied in different ways, and each has contributed to our overall understanding of teacher noticing (see B. Sherin & Star, this volume, chapter 5, for further discussion of these differences). In this chapter, our approach differs from what we have done previously; we focus exclusively on a single component of noticing—that of attending to events. Our focus here on attending derives not from a theoretical shift in our understanding of noticing—we continue to view attending and interpreting as closely related processes. Instead, our reason for this focus is opportunistic. We aim to capitalize on a technology that provides a new window into teacher noticing, and teacher attention in particular.

Current Methodologies for Studying Teacher Noticing

Although researchers have made progress in studying and characterizing mathematics teacher noticing, investigating that noticing has posed formidable methodological challenges. In other domains, a common approach for studying what people notice while performing an activity is to ask them to think aloud and verbalize what they are seeing and thinking while it occurs (Ericsson & Simon, 1993). Asking teachers to verbalize their thinking in the midst of a realistic teaching situation, however, proves unfeasible because of the ongoing nature of teaching. Instead, researchers rely on three main alternatives for accessing teacher noticing.

One approach involves providing teachers with samples of others' teaching and asking them to describe what they notice. In some cases, the episodes of teaching take the form of still images of classroom instruction (Carter, Cushing, Sabers, Stein & Berliner, 1988). More commonly, they consist of video clips of lessons (Colestock & Sherin, 2009; Copeland, 1994; Kersting, 2008). The main purpose of using this approach is to investigate the kinds of interactions and events to which teachers generally attend when viewing instructional situations. One

benefit of such studies is that they provide information on how a range of teachers respond to a common excerpt of instruction. One concern, however, is that a teacher's noticing in these situations may differ significantly from the teacher's noticing in the classroom. In particular, teachers consider the images without having the same level of information they have about their own instruction, such as familiarity with students and with the specific lesson.

In a second, related approach, researchers ask teachers to retrospectively recall what they were seeing and thinking during their own instruction. The retrospective recall may take place immediately following instruction without any visual reminders of what happened (Borko & Livingston, 1989); alternatively the teacher may view a video from his or her own classroom (Ainley & Luntley, 2007; Rosaen, Lundeberg, Cooper, Fritzen & Terpstra, 2008). Furthermore, in some cases, teachers are asked to discuss their instruction in individual interviews, whereas in other cases teachers are organized in groups to watch and discuss excerpts of their teaching with peers (M. G. Sherin & van Es, 2009). Teachers may find reflecting on classroom activity and articulating what they notice easier in this retrospective–recall situation because they do not have to respond immediately to what they notice. Still, a concern with using this approach is that, because the teachers have been removed from the demands of the classroom, their recollections may not accurately reflect their in-the-moment experiences.

Third, instead of relying on self-reports, some researchers explore teacher noticing by making inferences from videotapes of instruction, claiming that visible actions on the part of a teacher can provide evidence concerning what the teacher notices. For example, a teacher acting in response to a specific event constitutes evidence that the teacher attended to the event. Recently, researchers have used this methodology to investigate the extent to which teachers pay attention to students' thinking and to issues of classroom assessment (Levin, Hammer & Coffey, 2009; Pierson, 2008). Although this approach has received somewhat limited attention in the study of teacher noticing, it has been used extensively to investigate other aspects of teachers' expertise, including subject matter and pedagogical content knowledge (e.g., Putnam, 1992; Rowland, Huckstep, & Thwaites, 2005) or beliefs about teaching and learning (Cooney, 1985; Schoenfeld, 1998). Nevertheless, this approach also has limitations. Precisely characterizing what aspects of the classroom teachers are noticing on the basis of their observable responses and behaviors is difficult. Furthermore, teachers may attend to events and interactions that are not directly linked to an instructional move and, therefore, would not be identified in this type of analysis.

Applying New Technology to Study In-the-Moment Noticing

As described above, one reason these three methodologies are commonly used to study noticing is the difficulty, if not impossibility, of accessing teacher noticing while it happens naturally in the midst of instruction. Stopping a lesson

midstream and asking a teacher on what his or her attention is focused is impractical, given the ongoing nature of teaching. Recent advances in technology, however, have provided a new avenue for exploring in-the-moment noticing. Specifically, some portable video cameras are now equipped with selective-archiving capability, which enables the user to select moments of video to capture immediately after they occur. Because the cameras are intended to address increasing interest in recording moments of informal interaction,² the burden of recording is typically fairly low so as not to interfere with the ongoing nature of activity in natural settings (Hayes, 2006).

For this chapter, we draw on data in which high school teachers used a video camera equipped with selective-archiving capability. The *Deja View Camwear 100* includes two components (Reich, Goldberg, & Hudek, 2004):³ The first is a wearable camera approximately 1-inch long that can be affixed to one's glasses or to the bill of a hat; the second is a small recording module that can be attached to a belt. The camera records continuously in a loop mode, recording over previously recorded material after a short time. Pressing the save button on the recording module interrupts this process and saves the previous 30 seconds of video in a digital-media file. The media file is stored on a video card that is housed in the recording module. Another interesting feature of the *Camwear 100* is that it records instruction from the teacher's point of view in contrast to the more common back-of-the-room perspective (see Miller, this volume, chapter 4, for a discussion of teacher-perspective video). In this chapter, however, we focus only on the affordances of the camera that arise from its selective-archiving capability.

The data for this chapter were drawn from a study of 13 high school mathematics and science teachers who volunteered to use the *Camwear 100*. We focused on eight mathematics teachers, each of whom used the camera for one class period on up to four days. The teachers taught in two diversely populated school districts in the Midwestern United States. Their teaching experience ranged from 3 to 13 years in the classroom. In addition, three of the teachers had previous experience using video in their teacher education programs, and two had recently developed video portfolios of their teaching as part of an application for National Board certification.

Prior to each teacher's initial use of the camera, a researcher met with the teacher to introduce the camera and to find out about the class that the teacher had selected to videotape. On the day of the taping, the teacher was outfitted with the camera and was asked to "press the record button on the camera when something interesting happens in class, when something seems interesting to you."⁴ The prompt was intentionally open-ended to allow the teachers to define *interesting* in their own ways while teaching. No limit was given on the number of moments the teacher could capture. Also, the researcher videotaped the entire lesson using a standard video camera stationed in the back of the room.

Later on the same day, the researcher interviewed the teacher for approximately 45 minutes. Although we had developed a standard protocol, the interviews were

relatively unstructured and conversational in style. Each interview was videotaped, summarized, and partially transcribed. In total we conducted 24 interviews with mathematics teachers over the course of two school years.

The interview protocol we used with teachers consisted of three parts. First, the teacher was asked to describe the experience of using the camera that day and to say whether it had seemed to interfere with classroom instruction. Second, the researcher and teacher watched each of the captured moments, but only until the teacher remembered why that moment had been captured. Specifically, a still image of the start of the captured clip was initially displayed for the teacher. If the teacher could recall why he or she had captured the clip from the image, the video clip itself was not reviewed. Otherwise the clip was played only until the teacher recalled why it had been captured. This process was developed to avoid, as much as possible, having the teacher retrospectively develop an account of why he or she had opted to save that particular moment. The teacher was asked to describe the reasons the moment had been captured. Third, after viewing and discussing all the clips from that day, the researcher asked whether the captured clips represented what the teacher had intended and whether the teacher was aware of using any specific criteria to select interesting moments.

Capitalizing on This New Technology to Study Noticing

This new methodology provided us with a wealth of data about teacher noticing. Both teachers' captured clips and their discussion of those clips in the interviews gave us windows into their noticing. In other work, we conducted systematic analyses of the noticing of a particular teacher in our sample (Colestock, 2009; Luna, Russ, & Colestock, 2009; M. G. Sherin, Russ, Sherin, & Colestock, 2008). In this chapter, instead of attempting to characterize the noticing of a single teacher, we look across our data to consider the effectiveness of this methodology for assessing teacher noticing. In doing so, we explore what we are learning about accessing teacher noticing when we use the new camera.

Methodological Successes in Accessing Noticing

First, capturing moments with the camera was both a sensible and a feasible task to the teachers; they understood what they were supposed to do and were able to do it. On average, teachers captured 18 clips per hour of instruction. Furthermore, teachers typically captured moments throughout the lesson—at the beginning, middle, and end of class. Even though teachers' in-the-moment noticing may be so tacit that it at times is “almost a physical reaction,” teachers were able to identify individual moments as worthy of capture. Thus our teachers seemed to possess what Mason has called an *awareness of awareness*; they were both noticing and conscious of the fact that they were noticing (Mason, 1998). Because of this consciousness, we were able to use our methodology successfully in capturing

some component of teacher noticing. In particular, we imagine that in the midst of instruction pressing the capture button on the camera enabled the teachers to call out particular moments that stood out to them (Frederiksen, 1992).

Not only were our teachers sufficiently conscious of their noticing to be able to capture it, but they were also aware enough of those events to be able to differentiate various kinds. For example, in some cases, we asked teachers not to select everything that stood out to them as interesting but instead to focus only on those moments that were *especially* important or interesting. Although we might have imagined that noticing would be so automatic that this task would be impossible—that teachers would lack sufficient access to their thinking about their noticing to distinguish between such moments—teachers found this to be a feasible task. For instance, when talking with a researcher, Maria compared the quality of the thinking she noticed in different clips; she noted, “That [student idea] ranks up there pretty high for me” when compared with other moments. Similarly, Maria distinguished between moments by ranking them on a scale of 1 to 10; she said, “On a conceptual scale, I think [this clip] might be like a 4 whereas [this other clip] might have been around a 6 or 7.” Again, our central claim is that teachers are aware both of having noticed events in class and of their thinking about those events—and using our methodology we are able to document these awarenesses.

Our data from the interviews with teachers also seem to provide a window into teachers' in-the-moment noticing. In particular, our initial concern that the interview might prompt teachers to create an ad hoc, retrospective account of their noticing that was not equivalent to their in-the-moment noticing seems not to have materialized. During the interview, many of our teachers were able to quickly recall what they had noticed and captured in the midst of instruction simply from being shown the still image or only a few seconds of video, often showing recognition of the moment by visibly reacting or saying, “Oh, yeah,” before going on to describe their noticing.

In addition, some teachers correctly predicted what moment was captured in a subsequent clip without viewing it. For example, in reflecting on a clip in which students were matching slope fields to differential equations, Todd said, “So [the student] matched 7 [the slope field] and A [the differential equation], but the next clip is her saying, ‘Oh, wait a second; I think I made a mistake.’” Notice that, even without viewing “the next clip,” Todd was able to recall what class activity he had noticed and captured during class. The speed and ease with which teachers recognized moments from class with little (or no) aid from the video indicates that the teachers were not relying on the videos to help them recreate an account of their thinking but were instead using the video as a cue to help them recall their thinking from earlier in the day.

Finally, when teachers did not remember the moment they had captured or their reason for capturing it, they seemed to feel comfortable telling us so in the interview rather than constructing some explanation on the basis of the classroom

activity they viewed in the video. Again, we believe that teachers were not using the video as a record of activity they could notice but instead were using it to cue prior noticing. Thus we assert that the interviews in fact tapped teachers' in-the-moment noticing even though they took place after instruction.

Methodological Challenges in Accessing Noticing

Despite these successes, using this methodology has not been entirely straightforward. Specifically, we may not be accessing the full range of teachers' noticing—because we were unable either to capture the noticing itself or to access teachers' thinking about their noticing.

When we began using the camera with teachers, an initial concern centered on the fact that each clip a teacher captured with the camera was, by default, 30 seconds in duration. We imagined a number of potential problems this time restriction might impose. First, teachers might find it logistically difficult to know when to press the record button to capture in that 30-second window the aspect of class that interested them. In addition, we thought that 30 seconds might be either too short or too long to capture what teachers noticed—and that having too much or too little information in the video clip would obscure the very access to teachers' noticing that we were trying to achieve.

Although some teachers did initially have difficulty timing their capture to record what interested them, with practice the teachers were able to record at least a portion of the moment they intended to capture. When asked whether individual clips represented what they had intended, most teachers responded “Yes,” or identified only one or two clips from each day that failed to do so. Also, when teachers had captured only a portion of the intended episode, viewing just that portion in the interview was usually sufficient to cue the entire moment. For example, when reviewing one clip, Ray said, “Oh, so I missed a lot of it. . . . I didn't get that [student talking].” Despite having missed most of the moment he had intended to capture, he was still able to talk about his noticing: “I know exactly why I [captured] that.” Thus, the logistical difficulties of capturing noticed moments with the camera were at least partially overcome by talking about those moments in the interview.

Similarly, when a noticed moment was either shorter or longer than the 30-second time window, the interviews played an important role in providing access to the teachers' noticing. Specifically, at times, teachers commented that what stood out to them was, in fact, much less than 30 seconds and more like “just the last 3 to 4 seconds.” In such cases, however, the teachers had no difficulty identifying that smaller moment from the 30-second clip. In other cases, although the clip was limited to 30 seconds, teachers talked about what they had noticed as extending beyond that time. For instance, Ray explained, “What was happening [was that] I was going around checking homework . . . and I got to that group . . . and that was probably the fourth group in a row [that] had done the graph wrong.”

Although Ray captured a moment from his conversation with the fourth group of students, he characterized what he had noticed as including events prior to that time. Similarly, for many of our teachers, the moments they had noticed extended beyond the 30-second clip, and yet the clip was sufficient to cue, in the interview, their memories of their noticing. Note that, although the time limit for the clips did place constraints on our abilities to access the entirety of teachers' noticing, through our interviews with the teachers we overcame those challenges.

However, we have yet to address other issues of accessing teachers' in-the-moment noticing with this methodology. First, at times teachers reported simply failing to use the camera because they were so involved in their everyday practices. For example, Diane said,

Sometimes I think I just got caught up in the actual business of going about doing class, and there might have been moments that I wouldn't have thought to press, like, that were interesting if I . . . Like, if I watched your videotape of those moments, I might be like, "Oh, yeah, actually that was something," but I didn't think to press the button then.

Diane pointed out that sometimes the work of teaching was such that she was unable to capture moments. Perhaps it was the case that Diane simply forgot to use the camera, as other teachers reported had occurred sometimes. Cassie, for example, said, "I actually forgot I was wearing it at one point, and then I suddenly thought, 'Oh wait.' I, I should be thinking about 'Should I hit the button or not?'" Alternatively, perhaps Diane was unable to use the camera because of the cognitive intensity of teaching at that moment. That is, sometimes the demands of teaching are so extreme that it is difficult to be sufficiently conscious both of what one is noticing and of the need to capture it with the camera.

Second, even if teachers capture moments they notice, we may fail to tap their thinking about those moments. As mentioned previously, at times during the interviews, teachers reported forgetting why they had captured a moment. For example, Cassie said, "I don't know why I pushed the button there, but I know I actively did because I can see myself looking at [the button as I pressed] it." Cassie knew that she had used the camera to capture something she had noticed but could not recall what it was. Thus, although the capturing technology documented her noticing, we obtained no information about the nature of her noticing in that particular moment.

Third, we suspect that the act of wearing the camera and capturing moments might change the very noticing we hope to access. Although, overall, teachers mentioned that wearing the camera did not interfere with their instructional responsibilities, a few reported that their noticing itself was altered in some ways. Some teachers reported that the camera heightened their attention in the classroom. For example, Mark said, "I felt what [the camera] did was it, it made me more aware of what I thought was important." Teachers' use of the camera may

have made explicit some portions of their noticing that are normally more tacit in the classroom. Other teachers felt that wearing the camera did not heighten their noticing but instead altered their experiences of the moment. For example, Sean compared using this camera to taking pictures:

Well, it's sort of like what, whenever you're using a camera, at least for me, I find like, I mean it's great tak —. Taking pictures is fun except that it always at some level takes you out of that moment. So instead of just living it you're focused on capturing it.

Because wearing the camera altered Sean's experience in the moments of teaching, his noticing was also likely altered. Thus, at least in his case, we might not have accessed his natural, in-the-moment noticing. In other cases, a few teachers reported not that their noticing changed but that their teaching changed as a result of using the camera. For instance, Sean noted, "The kind of capturing you're doing of your teaching . . . starts to direct the focus of your teaching." Other teachers reported changing their teaching to create moments of classroom activity to capture. For example, Ray said,

I think I did change things a little bit. . . . I think the discussions, particularly the large class discussions that we had, probably went on longer than I would have done normally. Because I was trying to find something [interesting to capture]. . . . Actually it was a good thing . . . because I would have ploughed through that real quick and not spent as much time discussing it. . . . So I definitely modified things a bit based on [using the camera].

Similarly, Kelly said,

Well, maybe I tried to have a little more pause time sometimes just to see like, "Is there anything interesting going to happen?" I'm going to give [the students] a little more of a chance to come up with something.

For both Ray and Kelly, trying to capture moments altered their teaching, which in turn altered the kinds of moments they were able to capture.

Because of these challenges—the ways in which our methodology occasionally influenced and changed the very phenomenon we were attempting to access—we need to be cautious in framing our data and conclusions as speaking to the character of noticing as it takes place in everyday classroom teaching.

Discussion

Although the challenges discussed previously will require our further attention while we continue this work, overall we believe that there is reason to be

optimistic about the potential to study teachers' in-the-moment noticing using the methodology we introduce here. Teachers were able to use the new camera with minimal disruption to their teaching, and in the follow-up interviews they appeared to describe their thinking during instruction without much difficulty.

We wondered, however, about the relationship between the noticing we accessed with this camera and the noticing that other researchers document with their methodologies. In particular, we wondered to what extent the phenomenon we thought we were accessing—teachers' in-the-moment noticing—resembled the noticing accessed and described by other researchers.

To address this question, we examined the data we collected and compared them to the results from other work on noticing. For example, some researchers have attempted to categorize the subject of teachers' noticing. Star and his colleagues (Star et al., this volume, chapter 8; Star & Strickland, 2008) explored preservice teachers' noticing in the areas of classroom environment, classroom management, tasks, mathematical content, and communication. In other work, Borko, Jacobs, Eiteljorg, and Pittman (2008) categorized what teachers noticed in classroom videos pertaining to teachers' thinking, students' thinking, mathematics, or pedagogy. We wondered whether we would find a similar variety among the teachers' comments about the clips they had captured—and in looking across the data we saw that we did.

In some cases, teachers explained that they had selected a particular moment because it reflected a student's comment that they found interesting mathematically. For example, Carla, an Algebra I teacher, commented about a clip that "was prompted by Larry's question [about parametric equations] . . . whether or not we should include t when we say the horizontal change is 4, or if it's $4t$." In other cases, teachers indicated that a moment had been noteworthy because of student participation at the time. For instance, Amy mentioned capturing a clip because "I was excited that Janelle was offering up an idea." Teachers also claimed that some moments of instruction stood out to them "more because of something I did . . . than something they did." During a geometry lesson one day, Diane challenged her students to decide whether a Pythagorean triple was primitive.⁵ She explained, "At the time, I was proud of myself for working that in. I was like, 'Oh yeah!'" In addition, teachers explained that some clips they had collected reflected a focus on organizational aspects of instruction such as distributing and collecting materials and monitoring the durations of particular activities.

Such comments indicate that our teachers attended to a variety of issues in the classroom. Thus at least the subjects that teachers raised as the foci of their noticing, using our new methodology, are similar to those that other researchers have documented. More broadly, we believe that this finding provides validation that we are working in the same territory as others who study teacher noticing.

Given this validation, we next asked whether, in this context, we have seen anything unique about teacher noticing. This issue is the focus of ongoing analysis, and we present just one dimension that we suspect will be important in future

work. Specifically, our teachers often selected moments to capture because of how well they aligned with their expectations for their lessons. In fact, teachers commonly suggested that events captured their attention because they were surprising. The surprise might be a student's participation that was unexpected, as when Diane explained, "Sylvia's one of those students who doesn't normally raise her hand." Other times, it was a mathematical idea raised by a student that was unexpected. As Ray explained,

I was trying to get them to discover how to solve absolute-value equations, and I didn't really expect anybody to know how to do it with a more complicated question . . . but then [Noel] explained the exact way to do it, and I was kind of like "That was an interesting thing that happened because I really didn't expect anybody to be able to do that."

Both Diane and Ray seem to have noticed the moments they did because, in those moments, the classroom activity deviated from their expectations.

In other cases, teachers captured moments because those moments reflected expected classroom activity. For example, Amy explained, "The reason I picked this is . . . Dan always asks that question. . . . And I really appreciate [when he does that]." Similarly, Ray noted a clip he had selected because it pertained to a familiar concern: "[Students] are all working on the project . . . but nobody's writing anything down. . . . I think that's a particular problem we have in this school." In these moments, Amy and Ray seemed to have been struck by how well what they perceived matched their expectations.

Thus the noticing of many of our teachers is driven by their continuous, tacit comparisons to their expectations. This finding is consistent with models of perception discussed by cognitive scientists in that one continually evaluates the goodness of fit between one's current model of the world and data perceived from the world (Rumelhart, 1980). Similar ideas have been presented in the literature on teacher cognition. Specifically, Leinhardt (1989) claimed that, for expert teachers, the process of instruction includes implicit "checkpoints" at which point teachers gather information about how a lesson is proceeding (p. 55). Our point, therefore, is not that these claims about teacher perception are new per se but rather that our methodology enabled us to uncover this process in a new way. Schoenfeld's (1998, 2010) models of teachers' in-the-moment decision making are similar to our findings, yet his inferences are based on fine-grained analyses of videos of instruction. We believe that our methodology adds a valuable layer by indicating key moments of instruction as experienced by the teacher. Furthermore, researchers studying teacher noticing have not yet explored the relationship between teachers' noticing and teachers' expectations for a lesson. We suspect that this is a productive direction for research.

The analyses that we have conducted thus far indicate that this new methodology is a worthwhile tool to add to our repertoire of strategies for investigating

teacher noticing. As discussed previously, analysis of the data reveals similarities with themes reported in other research, particularly with respect to the kinds of issues to which teachers attend while teaching. In addition, our methodologies may be used to uncover processes, such as alignment with expectations, that have been inaccessible previously. To be clear, despite the positive results from these analyses, we do not expect the methods we describe to replace existing approaches. Rather, we imagine that using such cameras in conjunction with other methods will provide researchers with richer portraits of how teachers make sense of events that take place during instruction. Moreover, we recognize that more work is needed to fully capitalize on the affordances of cameras such as the Camwear 100. In particular, questions remain about the relationship between teacher noticing as it is revealed by the camera and the noticing in which teachers naturally engage during instruction.

Conclusion

At the start of this chapter, we raised questions about whether teachers' descriptions of their noticing do in fact describe their noticing as it takes place during instruction. In particular, we wondered whether one might reasonably expect Mark and Sean to accurately describe their in-the-moment thinking when they were removed from that thinking and in the context of an interview or video club. This question motivated us to seek a new methodology that would enable us to tap teachers' in-the-moment noticing without the distortion that could result from examining it in a time and place removed from its occurrence. Although we have yet to answer our initial question about Mark and Sean, we believe that using the technology we have implemented will ultimately enable us to do so.

Specifically, we gained access to teachers' in-the-moment noticing by coordinating data from teachers' captured moments with their reflections on those moments in the interviews. Furthermore, note that, although the captured clips gave us that in-the-moment access, the clips alone were insufficient to represent the teachers' in-the-moment noticing. Even though these video clips represent classroom interactions from the teacher's physical perspective, literally "what the teacher sees," they cannot fully account for the attention and thinking that teachers engage in when they notice moments in their classrooms. Instead, the interviews were essential to the methodology; it is through the teachers' comments during the interview that we learned what portion of the lesson and of the video clip had caught their attention and why those moments were selected.

We suspect that the combination of capturing clips with the camera and reviewing those clips may be a valuable activity for teachers as well. As discussed previously, some teachers commented that wearing the camera heightened their awareness of when important events took place in their classrooms. Similarly, a few teachers noted the difference between commenting on video that was captured with the new camera and video captured with more traditional methods.

For example, Ray thought that he would be unable to recall all those moments that he had thought were interesting in the moment of instruction if he were to review a video of the whole lesson after class: “I think [I’d remember] only 3 or 4 [of the 10 I captured]. ‘Cause a lot of them are just, well, spur-of-the-moment type.” Similarly, Maria commented,

I think the thing with pressing the button is important because there is this intense meta, meta-cognition, meta-pedagogical thing happening, because you really have to be in the moment to know that last 30 seconds was important. It is a lot different than watching it two days later as a whole chunk and not being able to really hone in on what those were.

Maria’s statement points to the benefits of both wearing the camera and trying to be aware of what is happening in the moment, as well as to revisiting those moments at a later time. Although part of the power of noticing, for teachers, is its unconscious and automatic nature, we believe that making this process more explicit for teachers is potentially a worthwhile form of professional development. In particular, the process of capturing moments of instruction—of making choices about when to press the save button—as well as returning to those moments outside of class may provide needed support for teachers to define and articulate their thinking in ways that might otherwise be too tacit to express. Thus we imagine that this methodology is valuable not only for those interested in understanding teachers’ noticing but also for teachers who want to better harness that noticing to parse their classrooms in meaningful and productive ways.

Notes

- 1 This research is supported by the National Science Foundation under Grant No. REC-0133900 and by the Edison Venture Fund. The opinions expressed are those of the authors and do not necessarily reflect the views of the supporting agencies.
- 2 In July 2008, the *Wall Street Journal* reported that the YouTube platform hosts more than 1 billion views per day.
- 3 Another camera featuring selective-archiving potential is the POV 1.5 (www.vio-pov.com).
- 4 Some variations of this prompt were used as well.
- 5 A primitive Pythagorean triple consists of three positive integers, a , b , c , which are coprime and satisfy the equation $a^2 + b^2 = c^2$.

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