TEACHER NOTICING IN-THE-MOMENT OF INSTRUCTION: THE CASE OF ONE HIGH-SCHOOL SCIENCE TEACHER

Enacting science education reforms that call for the teaching of science as argument and explanation (NRC, 1996) requires that teachers both recognize student thinking as it happens and make in-the-moment instructional responses to what they notice. Much work in teacher education is thus devoted to studying, supporting, and improving teacher noticing (e.g. Sherin, 2001). However, although there is agreement that we want teachers to notice their students’ thinking, we still know very little about what science teachers actually attend to in the moment of instruction. In this work we report on the use of a new video technology, the Camwear 100 (Reich, Goldberg, & Hudek, 2004) that allows us to capture in real time what teachers notice in the classroom during teaching from their own perspective. In addition, reflection interviews with teachers after instruction provide insight into why they notice the things that they do. Here we focus specifically on one high school biology teacher’s use of the camera and explore her thinking surrounding her noticing. We also discuss the implications of this work for the study of teacher noticing.

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Introduction

Recent science education reform efforts that call for educators to shift from teaching science as vocabulary and facts to teaching science as argument and explanation (NRC, 1996) undoubtedly place great demands on science teachers (Bencze & Hodson, 1999; Davis, 2003; van Driel, Beijaard, & Verloop, 2001). Teachers must recognize students’ thinking—their arguments, explanations, questions, and ideas—as it happens and make in-the-moment instructional choices in response to what they notice. Rodgers (2002) argues that teachers need to develop this ability “to see student learning: to discern, differentiate, and describe the elements of that learning, to analyze the learning and to respond” (p.231). Other researchers have also described this ability to see and respond as necessary for effective teaching (Ball & Cohen, 1999; Berliner, 1994; Sherin, 2001, 2007). Specific to science teaching, Hammer and van Zee (2006) also argue that teachers must attend to and respond to student thinking in order for meaningful science learning to happen. Because it is perceived as so important, many teacher education programs, professional development, and curriculum materials explicitly support teachers in learning how to notice and respond to students’ thinking and reasoning (Ball & Cohen, 1999; Schneider & Krajcik, 2002).

Although there is agreement about what we want teachers to notice in science classrooms, we still know very little about what science teachers actually notice in the moments of instruction. Do science teachers pay attention to student thinking and reasoning as we want them to? If they do, then how do they describe such moments? If they don’t, then what other classroom moments capture their attention and why? The answers to these questions are necessary if we are to understand how to support teachers in shifting their teaching practice towards a pedagogy of
science as argument and explanation by careful noticing and responding to the ways their students think and reason about the physical world.

This work begins to answer these questions by exploring the terrain of what is noticed in the science classroom by one high school biology teacher. We begin by briefly reviewing previous work on teacher noticing within the fields of mathematics and science education and define how our current study is a departure from that work. We then describe our methodology that makes use of new video technology that affords us a glimpse into teacher noticing as it happens in the very moments of instruction. We present a summary of the kinds of classroom events one teacher captured using the camera and her reflections on those moments in particular. In particular we discuss how the kinds of moments this teacher identified depended heavily on the kind of activity in the classroom. We also characterize patterns in the ways the teacher reflected on her captured moments. Finally we raise issues surrounding the use of this kind of methodology for studying teacher noticing and outline the future directions for this work.

Teacher Noticing
Researchers who study teacher noticing do not necessarily share a common definition for this term. Miller and his colleagues (2008), for example, describe teacher noticing from a cognitive perspective as the ability to quickly identify and comprehend the meaningful elements in an environment. Miller is interested in what is being paid attention to and the sense that is being made of it, while, Jacobs and colleagues (2007) are interested in not only what is noticed but also in the teacher’s response to what is noticed. Some researchers want to figure out the types of things noticed (Sherin, Rich & Colestock, 2008), while others want to influence what is noticed in the first place (Santagata et. al., 2007). Sherin’s (2001, 2007) idea of a teacher’s professional vision, patterned after Goodwin’s (1994) characterization of how different members of professional groups look at relevant phenomena, involves the ability to notice and interpret significant events in a classroom. Here we define teacher noticing as a teacher’s noticed moment, her understanding of that moment, and her response to that moment.

Prior work on teacher noticing has attempted to generally characterize the differences in how and what teachers notice. Following in the footsteps of other novice/expert studies (e.g. Glaser and Chi, 1988), researchers have demonstrated that expert teachers viewing video of classroom episodes monitor, interpret, and recall classroom events in more detail and with more insight than novice teachers (Peterson & Comeaux, 1987; Sabers, Cushing, & Berliner, 1991). They attributed this ability to the ease of processing afforded by the rich and complex schemas for classroom events that experienced teachers had built up over many hours of classroom teaching.

Other researchers have focused more specifically on trying to identify the specific kinds of things that teachers tend to notice. van Es and Sherin (2002), for example, have described the kinds of classroom activities and events math teachers report attending to when reviewing a videotaped lesson during a one-on-one interview. These authors found that teachers report noticing classroom talk, behaviors, artifacts and tools, interactions, or the structure of the environment. Research also that suggests that mathematics teachers’ attention is initially drawn to issues of classroom organization and general instructional practices when viewing video, rather than to the substantive nature of the mathematics that is being discussed (Frederiksen et al., 1998; Sherin & Han, 2004).
Beyond simply characterizing what teachers typically notice, researchers have also attempted to influence what teachers attend to while watching video with the goal of eventually changing their practice. Sherin and colleagues have studied how teachers’ noticing shifted from focusing on teachers instructional actions to an increased focus on student mathematical thinking as they engaged in “video clubs,” which typically involve groups of teachers interacting with a facilitator as they watch and interpret videos from one another’s classrooms (Sherin, 2007; Sherin & Han, 2004). Star and Strickland (2008) measured pre-service mathematics teachers’ recall of events that they noticed in a video-taped lesson before and after a methods course in which they introduced a framework to direct teacher noticing and showed that their ability to notice and recall a wide range of features of the classroom environment improved as a result of taking the course. Frederiksen and colleagues (1998) present evidence that training teachers to notice certain aspects of teaching for the purpose of evaluating teacher video portfolios might also serve the purpose of helping them to improve their professional practice. In all of this work researchers do not look at teacher noticing as it occurs in-the-moment of instruction but rather ask teachers to reflect on video outside the context and pressures of teaching.

We suspect that teacher noticing as it occurs after the fact is likely significantly different from what they notice and attend to while they are in the midst of instruction. Support for this claim comes from Levin, Hammer, and Coffey (2009) who showed that although one pre-service teacher engaged in substantive discussion of student thinking during a science teaching methods course, she did not attend to that thinking during her classroom teaching. Although Levin and his colleagues do not attribute this difference merely to the fact that the science methods course allowed reflection outside of the demands of instruction, the phenomenon remains that what teachers notice in-the-moment and after the fact may differ. As Sherin and colleagues (2009) point out, “because video affords the luxury of time, the way that teachers attend to classroom events via video might be quite different from the sort-of instantaneous reaction they have during class” (p.31).

Our interest in this work is in what teachers notice during instruction as they are in the act of teaching. Thus if it is the case that teachers attend to different things at different times, we need a methodology that provides us more immediate access to that thinking than post-interviews or video clubs allow. Hammer and his colleagues (Levin, Hammer, & Coffey, 2009; Rosenberg, Hammer, & Phelan, 2006) have studied this kind of in-the-moment attention of science teachers by observing their classrooms and inferring what they must have noticed given their instructional responses. Sherin and colleagues (2009) shared our goal of tapping what they call “professional vision in-action” and attempted to access it more explicitly and directly than Hammer and his colleagues. They used a new video technology to identify one math teacher’s reasons for noticing certain classroom events in-the-moment of instruction. They categorized these reasons as involving student thinking, classroom discourse, teacher moves, teacher strategies, and student engagement.

Research Design and Methodology

In this work we follow the methodology used by Sherin and her colleagues (2009) to attempt to understand teacher noticing in-the-moment of instruction. We implemented a new video recording technology called the The Camwear 100 by Dejaview (Reich, Goldberg, & Hudek,
2004). The Camwear 100 is a tiny video camera that can be worn by teachers either on their glasses or on a hat and allows them to capture classroom events from their own perspective (Figure 1). This perspective stands in contrast to traditional video of classrooms that is collected from the researcher’s perspective (Figure 2).

![Figure 1. The Camwear 100 attached to a teacher’s hat.](image)

![Figure 2. A classroom from (a) the viewpoint of a traditionally positioned researcher’s camera in the back of the room, and (b) the viewpoint of the Camwear100 worn by a teacher.](image)

Most importantly for our interest here in in-the-moment noticing, the Camwear 100 also features after-the-fact technology. The camera continuously streams video and when the “record” button is pressed, the camera stores the previous 30 seconds of activity in a digital video file that can later be downloaded and viewed on a computer. This feature enables the teacher to observe a moment in class, decide that it is worthy of notice, and then after-the-fact save that moment for later reflection. Using this camera affords us opportunities to capture teachers’ online noticing because they decide what to save while they are engaged in the acts of teaching. Implementing this technology provides an alternative to either asking the teacher to retrospectively recall what they had noticed while they were teaching or asking them to view the video after class and comment on things they notice.

**The Study**

This work is part of a larger, ongoing research project examining math and science teachers’ noticing during instruction captured by this new technology. Sherin and colleagues (2009) report on piloted work with one high school math teacher. As a preliminary extension to that pilot work we
recruited ten high school science and mathematics teachers from a large urban area in the Midwest to try out the new technology. The teachers ranged in experience from 3 to 10 years. Some of them had experience using video to reflect on their teaching and others did not. For the purposes of this work, each teacher was paired with one researcher who conducted all phases of the study.

Here we report on how one science teacher engaged with the technology. Ms. Seaton (all names are pseudonyms) is a high school biology teacher who has been teaching for six years. She holds both a BS and MS degree in biology as well as an MS degree in education. She is state certified to teach secondary science and has prior experience using video to reflect on her teaching practice. The research reported here was conducted in one of her honors level biology classes, which consisted of 23 students who were both juniors and seniors. At the time of the study the class was studying cell form and function as well as enzyme diseases through discussion and labs. The current study involved two phases each designed to explore what she noticed while teaching: (1) having the teacher capture moments with the camera during class and (2) having her reflect on those moments after class with a researcher.

Phase 1: Capturing Noticed Moments
Ms. Seaton agreed to use the Camwear100 on three separate days in Fall 2008 school year. Prior to each class, Ms. Seaton met briefly with a researcher to review her plans for the lesson and to be fitted with the camera. While wearing the Camwear 100 during each scheduled class session, Ms. Seaton was given the following instruction: “Capture interesting moments by pressing the record button on the camera.” This prompt was intentionally vague in order to minimize the potential influence it could have on the types of classroom moments she might notice. We wanted the teacher to interpret for herself what an interesting moment in the classroom looked like and what warranted saving. During the same class period as Ms. Seaton collected her clips using the camera, a researcher used a separate video camera to record the entirety of the class session from the back or side of the room.

Phase 2: Reflecting on Captured Moments
After each of the three classes in which the teacher wore the Camwear 100, a researcher downloaded the captured clips for viewing onto a computer and then interviewed Ms. Seaton. The first part of these interviews was centered on understanding what it was like for the teacher to use the camera in class that day and probed the impact of the camera both on her teaching and her students’ behavior. Next the teacher and interviewer watched each 30-second clip until the teacher recognized the particular moment or event she intended to capture. She was then asked to describe why she had pushed the button at that moment and what was interesting about that moment. If there was time, the researcher then asked the teacher to discuss more generally what she had captured and how she interpreted the prompt to capture “interesting” moments. While there was a standard protocol the interviews were fairly unstructured, open-ended, and conversational in style. Each interview lasted approximately 40 minutes and was videotaped.

Analysis
During the preliminary part of the analysis, the researcher responsible for conducting the study with Ms. Seaton created a summary report of the data. She developed an account of each 30-second clip by coordinating a viewing of the clip itself with the videotape of the entire lesson in order to fill in the necessary context to situate the clip as part of a teaching episode. In addition,
the summary report also included a summary of the teacher’s comments about each of the clips from the post-interview. The purpose of this report was to help those not in the classroom at the time of the study understand important classroom context relevant to each clip and the teacher’s subsequent reflection.

After a summary report for each of the three interview days was developed, a team of three researchers worked together on the analysis of the resulting data from Phase 1 (the captured clips) and Phase 2 (the teachers reflection on the captured moments). For Phase 1 we took each 30-second clip as a unit of analysis; for Phase 2 the unit of analysis was the time during the interview in which the teacher discussed a particular clip. The analysis on those units consisted of both convergent and generative elements (Clement, 2000). That is, we used coding (convergent) methods to determine counts and average behavior and interpretive (generative) case study evidence to describe nuance and subtlety in the data.

When coding the data from Phase 1, the three researchers viewed and jointly coded each of the captured clips. We described each of the clips according to the participant structure evident in the clip, the classroom event depicted in the clip, and the primary participants. When coding this data we started with the codes developed by the research team of the larger project to characterize the full corpus of data from all ten teachers. To be clear, we use these codes for giving the reader a sense of the overall types of moments the teacher captured.

For Phase 2, the same three researchers viewed the post-interviews with the teacher and categorized what was interesting about each clip to the teacher. We began with an initial set of codes from Sherin et al. (2009) but modified them as necessary to account for this particular corpus of data. At the same time we applied this set of convergent codes to the data, we also viewed the data with an eye for other significant themes that emerged in the kinds of moments Ms. Seaton captured or in the way that she talked about them.

Results
In this analysis we attempt to provide the reader with a sense of both the kinds of moments Ms. Seaton found “interesting” and the ways in which she reflected on those moments. We begin by describing the nature and range of the classroom activity Ms. Seaton captured using the camera. We then discuss her thinking about the moments she captured as she talked about it in the post-interview with the researcher.

Captured Clips
For us, each clip that the teacher captures represents a teacher decision about an interesting classroom moment and helps us understand what kinds of events this science teacher finds noteworthy. Over the three days that Ms. Seaton used the camera in her class she captured a total of 54 clips using the camera. Accounting for the fact that the second day was a double period (lasting twice as long as the first and third days), Ms. Seaton captured an average of 13.5 clips in each 42-minute class period. This average indicates that Ms. Seaton identified interesting moments in her class on average every 3 minutes. While we cannot make any general empirical claims about whether one clip per three minutes of instructional time is “a lot” or “not very many,” our sense is that Ms. Seaton was capturing clips fairly frequently. One point of comparison informing our sense comes from a previous trial with a high school mathematics
teacher using the camera who captured moments on average every 9 minutes (Sherin et al., 2009). However, it is important to note that Ms. Seaton did not collect clips at regular intervals every three minutes; sometimes she captured moments back-to-back and sometimes the moments were spread out with longer time intervals in between them. In addition, she identified interesting moments throughout the entire class, which suggests that her noticing in class does not lessen over the course of a period.

That Ms. Seaton so regularly finds moments in her class interesting begs the question of what is happening that captures her attention. We observed four different participant structures (Phillips, 1972) in the individual clips she collected that were representative of the activity of the classroom as a whole. Teacher-Led Large Group Discussions describes classroom activity in which the teacher leads a discussion, either from the front of the room or elsewhere, and more than half of the students participate. The discussion may take a lecture format in which the students make only minimal contributions to the discourse or a more back-and-forth format with students and teachers asking and answering questions. Student-Led Large Group Discussions describe those times when students are responsible for guiding the discussion or presenting ideas to more than half the class. We use the term Lab Work to identify times in class when students are working in small groups with laboratory equipment to complete a procedure or activity. In Ms. Seaton’s class this activity took place in a different portion of the room setting it apart from the discussions both in location and in types of discourse and behavior evident. Finally, Transition describes times when the class is beginning, completing, or moving between better-defined activities (as at the start and end of the period).

Table 1 provides a summary of the number (and percent) of her clips that involved each participant structure. Ms. Seaton captured clips from all forms of activity in her class, including during transitions between activities. While this spread of participant structure is not particularly surprising, in retrospect we could imagine a teacher who only finds student-led discussions interesting or one who only finds students engaged in small group labs worthy of notice.

Table 1

<table>
<thead>
<tr>
<th>Participant Structure</th>
<th>Number (and Percent) of Clips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-Led Large Group Discussion</td>
<td>17 (31.5%)</td>
</tr>
<tr>
<td>Student-Led Large Group Discussion</td>
<td>13 (24.1%)</td>
</tr>
<tr>
<td>Lab Work</td>
<td>15 (27.7%)</td>
</tr>
<tr>
<td>Transition</td>
<td>9 (16.7%)</td>
</tr>
</tbody>
</table>

The range in participant structures that Ms. Seaton captured in her clips is generally consistent with the distribution of classroom activity overall on the three days she used the camera. On the first day of the trial (approximately 25% of the total time she used the camera), Ms. Seaton’s students were presenting in pairs (Student-Led Large Group Discussion) on their own research on enzyme disease. On day two, half of the double-class period was spent in lab work examining surface area and volume and part of the other time of the double period was spent in the classroom with the teacher presenting information (Teacher-Led Large Group Discussion) on cell form, function, and behavior. Finally on day three, the class period was primarily spent on a yeast cell observation lab. It does appear that the percentage of moments she identified in Teacher-Led Large Group Discussion is slightly higher than the percentage of time spent in that
activity overall in class. However, that the distribution of participant structure in her clips aligns reasonably well with the distribution of class activity suggests that Ms. Seaton not only found all the activity interesting but that for her the density of interesting moments was approximately equal in all the different activities. Interesting things are just as likely to happen during labs as they are during discussions or even during transitional time.

In addition to characterizing the general participation structures evident in the clips she collected, we also looked more closely at the particular classroom events that occurred in Ms. Seaton’s clips (Table 2). We identified five kinds of events, three of which involve substantive talk about the biological content (question and answer, explanation, question) and two of which do not (classroom logistics and casual talk). During Question and Answer talk the teacher and the students or the students with one another engage in a back and forth dialogue. In contrast, clips described as Explanation (or Question) typically involve one extended contribution from either a teacher or student that is just an explanation (or question) about the science content being discussed in class. Clips centered on Classroom Logistics are those where the teacher is giving students directions or describing classroom procedure (including safety warnings or explanations of assignment details). Finally, the teacher sometimes captures Casual Talk about non-science related topics.

Table 2

<table>
<thead>
<tr>
<th>Classroom Event</th>
<th>Number (and Percent) of Clips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question and Answer (Q&amp;A)</td>
<td>13 (24.1%)</td>
</tr>
<tr>
<td>Explanation</td>
<td>9 (16.7%)</td>
</tr>
<tr>
<td>Question</td>
<td>5 (9.3%)</td>
</tr>
<tr>
<td>Classroom Logistics</td>
<td>23 (42.5%)</td>
</tr>
<tr>
<td>Casual Talk</td>
<td>4 (7.4%)</td>
</tr>
</tbody>
</table>

Approximately half of Ms. Seaton’s clips involved substantive science talk (Q&A, Explanation, or Question) while the other half involved procedural oriented or non-science talk (Logistics and Casual Talk). That such a high percentage of her interesting moments captured non-substantive talk was surprising to us. Closer examination reveals a correlation between the kinds of classroom events that she notices and the participant structures in which they are noticed (Table 3).

Of the 15 clips Ms. Seaton captured during Lab Work time all but one of them was logistical or casual talk. We might expect this lack of attention to substance in the lab setting given that managing students as they engage in lab work (directions, procedural questions, safety issues) can be time-consuming and likely draw Ms. Seaton’s attention away from more substantive moments. However, we could also imagine a teacher who would notice the students’ talk about the science content in the lab. We have hints both during class and from the interview that Ms. Seaton does not consider the particular labs included in her school’s curriculum substantive or useful for the students’ understanding. It seems that Ms. Seaton does not expect the labs to promote or require substantive talk, thus it is not surprising that she does not capture any there. That she did not select moments with substantive content during labs may indicate either that the way the students engage in the labs is non-substantive or that the teacher just did not capture these substantive moments. We suspect that within this class the set of expected and appropriate
participation practices for the labs includes neither students engaging in substantive talk nor the teacher encouraging or attending to it.

Table 3
Number of clips by participant structure and classroom event.

<table>
<thead>
<tr>
<th>Participant Structure</th>
<th>Classroom Event</th>
<th>Number of Clips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Work</td>
<td>Substantive Talk</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Procedural Talk</td>
<td>14</td>
</tr>
<tr>
<td>Large Group Discussion</td>
<td>Substantive Talk</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Procedural Talk</td>
<td>4</td>
</tr>
</tbody>
</table>

The high amount of non-substantive talk Ms. Seaton notices (and in which the students engage) during lab work stands in contrast to what she captured during both teacher- and student-led large group discussions. Only 4 of the 30 clips she captured during discussions were logistical or casual talk in nature; the bulk of her clips involved talk by either the students or the teacher centered around the science concepts. It is important to note that in order for a teacher to capture a moment, the moment must first occur and then she must find it interesting. That substantive talk occurs during these discussions means both that her students are capable of it and that they consider it appropriate behavior for this participation structure. That she in turns finds those moments so regularly interesting means both that she is capable of noticing substantive science talk and that she considers such talk relevant and useful for this activity. Thus it appears that each participant structure consists of a particular set of expected practices for student and teacher engagement, activity, and discourse.

As a final pass at the clip data we characterized the clips according to who spoke during the 30-seconds. Ms. Seaton was the primary contributor to the discourse in only 3 of the 54 clips she collected. Most of the clips (70.4%) were exchanges between the students and the teacher and the remaining clips involved only students – either a single student or multiple students talking to one another. Thus it seems that students are almost always (94.4%) involved in the moments that Ms. Seaton finds interesting.

Teacher Reflections on the Clips

Summary of Teacher Reflections
In the post-class interview, Ms. Seaton discussed each of the clips she selected. In particular, she responded to questions about why she had collected that particular moment. From her reflections we identified five different reasons that she gave for capturing clips. To be clear, the language that we use to characterize these codes is our researchers’ interpretation of her comments and do not signify any particular terminology that she used. We coded Ms. Seaton’s reason for capturing a clip as Student Thinking when her focus was on the substance of the students’ ideas. Most often the substance of these ideas was related to the science content being discussed in class. We characterized Ms. Seaton as selecting a clip because of Students’ Engagement when she discussed how students participated in class. For example, she might say she captured a particular clip because all of her students were contributing to the discussion or because one student who usually asks questions does not. For clips described as referencing Student Characteristics, we looked for Ms. Seaton’s reflection to be about a specific attribute of a student.
or group of students. When she spoke on the nature or personality of her students, these were coded as being about student characteristics. We coded Ms. Seaton’s reason for capturing a clip as Discourse when she talked about the ways in which she and her students communicated. For example, Ms. Seaton might comment on how a student formed and articulated a specific question. To be clear, this would be coded discourse because Ms. Seaton’s reflection is not about the content of the question, but rather about the wording of the question. We characterized Ms. Seaton as capturing a clip for the reason of Task Management when she focused on how directions or lab procedures were being carried out by the students.

Table 4 lists each of the reasons we identified Ms. Seaton as giving for her clip capture, a corresponding quote from the interview that illustrates how she talked about these reasons, and the number (and percent) of total clips that received that code. There are some clips (14.8%) that Ms. Seaton does not remember capturing and thus that we did not code.

### Table 4

*Summary of Ms. Seaton’s reasons for clip capture.*

<table>
<thead>
<tr>
<th>Reason for Clip Capture</th>
<th>Example</th>
<th>Number (and Percent) of Clips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Thinking</td>
<td>“She [the student] had to understand that anorexia is both a mental and physical disorder and then apply that [in order to ask] how can a mental disorder be caused by an enzymatic deficiency?”</td>
<td>18 (33.3%)</td>
</tr>
<tr>
<td>Student Engagement</td>
<td>“The only reason it was interesting is because Zeb never asks questions. So I was like, wow, Zeb’s volunteering to ask a question, and it’s a good question. That’s interesting to me.”</td>
<td>8 (14.8%)</td>
</tr>
<tr>
<td>Student Characteristics</td>
<td>“Larry gives this persona of not caring and, you know, I’m the cool guy in class. And yet the first thing he does when he sits down, he wants to know if I thought he did a good job…it was this idea that even though he totally acts like a clown, he really does want me to respect him and to do a good job in class.”</td>
<td>23 (42.6%)</td>
</tr>
<tr>
<td>Discourse</td>
<td>“She [the student] thought it was a clarification question. I thought it was a content question. So clearly we were misunderstanding each other. It was probably somewhere in the middle. But, I just thought the miscommunication was interesting.”</td>
<td>9 (16.7%)</td>
</tr>
<tr>
<td>Task Management</td>
<td>“Josh put his test tube with congo red, yeast in it tipped way over on the side in the basket with the dropper bottles rather than getting a test tube rack…Its just interesting to me how some students, like Ed, is over there washing the test tube and Josh’s not even going to get a test tube rack.”</td>
<td>9 (16.7%)</td>
</tr>
</tbody>
</table>

As we reviewed Ms. Seaton’s interview we found that she sometimes offered multiple reasons for finding a particular moment interesting. As such, some of her reflections are double coded and thus the percents in Table 3 add up to more than 100%. Ms. Seaton most often referenced student characteristics (42.8%) when discussing why moments were interesting to her. However, out of the 23 instances of this code all but 6 of them appeared as double codes. This indicates
that Ms. Seaton often used student characteristics in addition to other factors to explain her thinking about interesting moments. In addition Ms. Seaton identified student thinking as catching her attention (33.3%) twice as often as engagement, discourse, or task management (all around 15%) suggesting that she is both capable of noticing that thinking and was generally more in tune with that thinking than engagement or management issues.

Earlier when discussing the activity evident in Ms. Seaton’s clips we described how she seemed to find different moments interesting depending on the classroom activity. In particular, we noted that when she captured clips during large group discussions they were more likely to involve substantive science talk than when she captured clips during lab work. This patterns further bears out in her reflections about why she captured those particular moments (Table 5).

Table 5

<table>
<thead>
<tr>
<th>Participant Structure</th>
<th>Reason for Clip Capture</th>
<th>Number of Clips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Group Discussion</td>
<td>Student Thinking</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Student Engagement</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Student Characteristics</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Discourse</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Task Management</td>
<td>0</td>
</tr>
<tr>
<td>Lab Work</td>
<td>Student Thinking</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Student Engagement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Student Characteristics</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Discourse</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Task Management</td>
<td>8</td>
</tr>
</tbody>
</table>

Of the 38 moments that she identified during large group discussions, Ms. Seaton described 16 (or 42.1%) of them as interesting to her because of the student thinking in the moment. However, she only talked about 10% of the lab clips (2 out of 20) as being interesting for the same reason. One possible reason for this discrepancy is that her attention during labs is focused on task management and how particular students work through the labs (16 out of 20 clips).

It is interesting to note that Ms. Seaton does not ever describe the moments she captures as about her own particular teaching moves or general pedagogical strategies. In contrast, the mathematics teacher described in Sherin et al. (2009) often notices his own teaching. For example his reflection includes comments such as:

This was one of those critical moments, where… I had just planned on brushing right through that and not spending any more time. But that’s where I made a decision to stop and see where is this going to go. (p. 38)

It is not clear why Ms. Seaton does not discuss her teaching in the way that Mr. Bryant did. It may be because her repertoire of teaching moves is fairly stable and thus not as likely to be held up for explicit reflection. It may be because she interpreted our prompt as being about the classroom as it existed outside of her—an interpretation supported by the fact that the camera she
wore was pointed away from her and on the students. It may in fact be because she does not find her own teaching interesting. That we cannot tease possible reasons apart speaks to the difficulty of interpreting the data from this complex system of noticing that involves the classroom with all its inherent complexity as well as the technology and the researcher prompt.

Patterns of Discussion in Teacher Reflections
During the post-interviews with Ms. Seaton, we identified a number of different patterns in the way she talked about the clips she captured. Below we discuss three of the most prominent trends in her reflections and acknowledge that these may not be directly related to the way she notices in the classroom but instead merely an artifact of discussing that noticing with the researcher.

Comparing across Moments.
When Ms. Seaton reflected on the different clips she had captured she often made comparisons between the clips. These comparisons took two different forms—one involving comparisons of the same student at two different times and the other involving a comparison between two different students doing ostensibly the same thing but in a different way.

As an example of the first form of comparison, Ms. Seaton discussed two consecutive clips she captured during the class presentations on the first day she used the camera. In her reflection she indicated that the reason she found the clip interesting had to do with the presentation style of the student presenter; the student had impressed her with how articulate and expressive she was. In the next clip the student’s presentation was much less fluent and he seemed uncomfortable at the front of the room. In reflecting on this second moment, Ms. Seaton directly contrasted the two presentation styles, which led her to question the pairing of students.

Not only was he [the second student] a poor speaker but he was so different than his partner [the first student], that [it] was confusing to me as to why they would pick to be partners.

Ms. Seaton also compared the same student at different times during class. For example, during one of the labs she captured a moment in which a student is confused about how many measurements she needed to make to calculate the volume of a cube. In the clip the teacher explains to the student that the length, width, and height in a cube are all the same. Later in the lab the same student asks another question that has to do with measuring the cube. In her reflection on this second moment the teacher references the first exchange.

It was interesting [that the student asked the second question] because clearly when she asked the question I did not answer her accurately enough that she understood what a cube was for her to apply it to the next part of the lab.

The teacher was making a comparison between the first clip and the second clip in terms of the student’s understanding of a cube and how it did not seem to change based on the teacher’s explanation. Interestingly, when this teacher discusses the second clip she uses her gestures to “point” back into the past to action in the previous clip to which she is comparing.
It is possible that in-the-moment, the clips the teacher compares were actually captured independent of one another and that it is only in describing them to the interviewer that the teacher begins to use a comparative method of reasoning. However, it is also possible that part of the reason Ms. Seaton captured the second in these sets of clips was that in-the-moment she was recognizing and making sense of what was happening only as it related to the first clip. Perhaps she made some judgments about interesting moments based solely on comparison. If this the case, then it would seem that the process of making comparisons is an integral part of teacher noticing. Further investigating the kinds of dimensions along which teachers make these comparisons might represent a promising path towards understanding their in-the-moment noticing.

**Descriptions of Student Thinking: Sense-Making and Evaluation.**

When Ms. Seaton discussed moments that she found interesting because of the student’s thinking, she reflected on that thinking in one of two distinct ways—either by trying to make sense of the thinking or by evaluating that thinking. When she engaged in sense making about the thinking Ms. Seaton tried to figure out the substance of the student’s idea, why the student might be thinking that, and how the student arrived at that thinking. This is the kind of noticing that Levin, Hammer, and Coffey (2009) argue is what we want teachers to engage in—for teachers to focus on the “sense of the idea from the student’s perspective” (p. 147). For example, in the clip below Ms. Seaton reflects on the student’s thought process behind a question the student asked about anorexia.

> I thought that was a great question…I thought her question was super interesting… because she had to understand that anorexia was both a mental and physical disorder and to apply that to how a mental disorder can be caused by an enzymatic deficiency. So she had to apply a lot of information that we haven’t explicitly talked about.

Here Ms. Seaton takes the student’s question and considers all the knowledge and thinking that must have gone into the question. In contrast to this sense-making pattern of discussing the clips, Ms. Seaton sometimes merely evaluated the student’s idea against canonical knowledge without trying to explain or make sense of it. For example, in the excerpt below Ms. Seaton describes her surprise by the student’s lack of understanding about tubers.

> And I thought that was interesting because a potato is something they eat all the time… [and] she [the student] didn’t know there was a plant associated with the potato. So that just blows my mind how little they understand about their world.

Here Ms. Seaton does not try to understand why the student might be having trouble understanding tubers; she only notices that the student is having trouble and is surprised by it. In her discussion over the three interview days, Ms. Seaton often attempted to make sense of her students’ thinking that was correct but sometimes fell into a more evaluative pattern of talk when reflecting on incorrect thinking.

**Interpretations of Interesting: Reminder, Stand-Alone, and Dynamic Moments.**

At the start of the study our prompt to all the teachers including Ms. Seaton was to use the camera to capture “interesting” moments in their classrooms. The prompt was intentionally vague and we did not define for teachers what interesting meant. The open-endedness of the
prompt was a particular research design decision; we wanted to find out how teachers interpreted “interesting” and what “interesting” meant to them in the context of their classroom. The ways teachers talked about captured clips gives us insight into how they enacted our general prompt.

During the discussion of some of her captured clips Ms. Seaton seemed to tacitly interpret interesting as those moments that cue her to consider particular teaching practices. These moments serve as “reminders” that she needs to do something differently in future classes. For example, when a particular student is unable to answer a question Ms. Seaton describes how she “just thought that [it] was interesting. Um, more for me [Ms. Seaton] as a teacher. I need to keep an eye on her [the student].” At other times interesting moments suggest to her places where in future classes she might put more instructional effort because students are not understanding the content as well as she would like. Other teachers in our sample also discussed this interpretation of interesting moments as reminders. For example, a high school mathematics teacher at another school explicitly discussed how she used the camera to capture moments as “reminders to myself of what I could be improving on or doing better.”

However, in discussing most of the clips Ms. Seaton captured she did not explicitly connect them to her own teaching. Instead these moments seemed to “stand alone” as interesting with their usefulness not made explicit. In these moments Ms. Seaton describes “interesting” as anything that struck her—almost a gut reaction to things she saw in the classroom. For example, she often starts her reflection on a moment by saying “I just think its really interesting…” and going on to describe the action in the clip. She even identifies one moment that is interesting even though it has nothing to do with the content or the class. For that moment she notes its lack of relevance by saying, “This is totally not biologically related but I just think it’s interesting.” For the purposes of this study Ms. Seaton often captured interesting moments that did not directly inform her pedagogical choices. However, we cannot say from this data whether there are other moments during class that do influence her teaching decisions.

Contrast these “reminder” and “stand alone” reflections on interesting moments that Ms. Seaton captured with the reflections of some other teachers in our study. While Ms. Seaton’s noticing as captured using this technology did not seem to affect her local moment-to-moment teaching decisions, other teachers’ noticing did serve to dynamically inform their teaching. For example, in his mathematics class Mr. Bryant, the teacher explored in Sherin et al. (2009), describes how one student’s comment about a particular solution pattern forced him to rethink his next move.

That was what threw me even more was not just that everybody had done it this way [the wrong way] but that her argument was fairly logical. So that is when I started thinking about okay how am I going to deal with this.

His discussion of the interesting moment highlights its role as a “dynamic” moment that impacts his teaching. How teachers discuss their selected clips gives us insight into how they interpreted the prompt to capture “interesting” moments. That insight will allow us to hone the prompt in future iterations of the study so that we can get closer to the noticing we want to understand.
Discussion

The Camwear 100 wearable video camera is a promising technology for studying teacher noticing in the moment of instruction. It allowed us to access real time teacher thinking about what moments she noticed during the pressures of instruction, which we suspect is different from what is noticed in post-hoc contexts.

In this study, Ms. Seaton noticed different kinds of moments during different classroom activities. During large group discussions, she primarily found moments of students’ thinking interesting whereas during lab work she attended more heavily to student task management. Additionally, when reflecting on these moments, she often discussed her students’ personalities indicating that she finds classroom moments potential sites for learning about who her students are. We need to be careful, however, in interpreting these results as meaning that “student thinking”, “task management”, and “student characteristics” were what Ms. Seaton actually noticed. Knowing what happens in the clips and her reflections does not necessarily directly map to the teachers’ in the moment thinking; we do not know what the teacher found interesting in those moments, only that she found something interesting enough within that activity to press the record button. Her reflections after the fact may still only be post-hoc constructions.

Despite this caveat, we believe it is reasonable to assume that the moments Ms. Seaton selected with the Camwear 100 were moments in which she was using her “ability to see”, her teacher noticing. We see her drawing on her “ability to see” in the post-class session interviews in which she typically was quick to give her reason for capturing each clip. If she were capturing clips without intention or without actually noticing anything in particular, it is likely her reasons for capturing such clips would have been vague or underspecified, which did not happen. In fact, Ms. Seaton clearly stated when she did not remember a particular moment and did not try to speculate on what was interesting about such moments.

This preliminary study only begins to map the terrain of the kinds of things teachers may notice in the science classroom and the reasons why they are noticed. While reform efforts continue to push teachers to notice and respond to their students’ scientific thinking, this work contributes to our understanding of what teachers actually notice—which may or may not align with those reform efforts. Until we know more about what teachers are attending to in the classroom, we cannot know how to help teachers attend to the kind of student thinking that leads to deeper and more meaningful science learning. Furthermore, we believe the kind of teacher noticing we accessed with this camera is contextually and experientially based, meaning what a teacher notices, her understanding, and response, is influenced by the surrounding people (students, colleagues, etc.) and context as well as her prior experiences (Bronfenbrenner, 1979; Levin, Hammer, & Coffey, 2009). Thus we expect that it is possible to intentionally influence teacher noticing through the manipulation of teachers’ experiences and contexts in teacher education, professional development, and through their use of curriculum materials. Future work could continue to map the space of what teachers notice and begin more theoretically motivated efforts to affect change in that noticing.

References


Rosenberg, S.A., Hammer, D., & Phelan (2006). Multiple epistemological coherences in an eight-