THE IN-THE-MOMENT NOTICING OF THE NOVICE MATHEMATICS TEACHER

Michael Jarry-Shore
Stanford University
mjarrysh@stanford.edu

Recent reforms urge teachers to support students in pursuing their own mathematical strategies. Yet, to support a student in pursuing a strategy that they themselves devise, teachers must first notice details in the student's mathematical thinking, often in-the-midst of instruction. In this study, I examined four novice teachers' noticing of students' thinking in-the-moment, as well as the types of knowledge teachers called upon to support them with this noticing. Teachers took part in a post-lesson interview, in which they discussed moments from a preceding lesson of theirs caught on video. Findings indicate that novice teachers relied most on knowledge they developed in their own classrooms (e.g., knowledge of their individual students) to support their in-the-moment noticing. These findings align with calls to prepare teachers to view their classrooms as rich sources of knowledge supportive of their instructional practice.

Keywords: Teacher Knowledge, Elementary School Education, Middle School Education, Teacher Education-Preservice

Introduction

Today's mathematics classroom looks quite unlike the mathematics classroom of old. While in the past, teachers typically modeled a single strategy for students to apply in solving a series of practice problems, today, teachers are to encourage students to author their own strategies (NCTM, 2014). Existing research has demonstrated that, when teachers teach in this way, student learning benefits (e.g., Fennema et al., 1996).

To support students in pursuing their own mathematical strategies, however, teachers must be keen observers, capable of noticing important details in students' strategies (Jacobs, Lamb & Philipp, 2010). Only after noticing what a student did and understands in using some strategy, can a teacher then respond in an informed manner (e.g., by suggesting an appropriate next step). In the absence of prior noticing, a teacher might lack an adequate understanding of the student's strategy and could thus respond by asking the student to abandon their chosen approach in favor of one recommended by the teacher.

A number of studies have examined what teachers notice. These studies, however, have typically focused on what teachers notice when watching classroom video (e.g., Sherin & van Es, 2005), and not the sort of live, in-the-moment noticing that helps teachers support students in pursuing their chosen strategies. Of the few studies that have examined teachers' in-the-moment noticing, most have involved teachers in possession of several, if not many, years of experience (Jacobs & Empson, 2016; Sherin, Russ, & Colestock, 2011). While some recent work (e.g., Dyer, 2013) has examined the in-the-moment noticing of more novice teachers, this remains an under-examined area in need of further study.

In the absence of a more refined understanding of the novice teacher's in-the-moment noticing, current programs of professional development focused on this important aspect of practice may fail to address the unique needs of the novice. Accordingly, this study examined the in-the-moment noticing of the novice mathematics teacher.

Theoretical Framework

Teacher Noticing

Framing "noticing." Teachers have likened the process of noticing to having something prick the senses, alerting one to the fact that something important and worthy of attention is occurring (Sherin, Russ, & Colestock, 2011). Some scholars have adopted a similar framing, focusing on what captures teachers' attention in their studies of noticing. For example, in their work on the noticing of pre-service teachers, Star, Lynch, and Perova (2011) examined what teachers identified as important or noteworthy when watching classroom video. Others have included not just what a teacher identifies as noteworthy in their description of noticing, but how teachers make sense of what they deem noteworthy, as well (Sherin & van Es, 2009).

A focus for noticing. While some have studied teachers' noticing of any and all "salient features of classroom instruction" (Star, Lynch, & Perova, 2011, p. 117), others have examined teachers' noticing of students' mathematical thinking, in particular. For example, in their research program, Jacobs. Lamb, Philipp, and Schappelle (2011) acknowledged being "less interested in identifying the variety of what teachers notice and more interested in how and the extent to which teachers notice children's mathematical thinking" (p. 99). To Jacobs, Lamb, and Philipp (2010), noticing children's mathematical thinking consists of three component parts: a) attending, b) interpreting, and c) deciding how to respond. "Attending" refers to the extent to which a teacher pays attention to what a student did in solving some mathematics problem. "Interpreting," on the other hand, refers to the extent to which a teacher pays attention to what a student understood in solving a problem. Finally, "deciding how to respond" refers to a teacher's intended response to a given student. Attending, interpreting, and deciding how to respond occur almost simultaneously, "as if constituting a single, integrated [act]" (p. 173).

In-the-moment noticing. In recent years, scholars have begun to focus less on what teachers notice when watching classroom video and more on what teachers notice in-the-midst of instruction. This shift appears motivated by an acknowledgement that noticing "in the classroom is quite complex – more so than [when watching video] … when teachers [are] given only a small slice of instruction to consider and extended time to do so" (Sherin & van Es, 2009, p. 33).

Jacobs and Empson (2016) developed a framework for teachers' in-the-moment noticing of children's mathematical thinking (Figure 1). According to this framework, what a teacher notices in children's mathematical thinking in-the-moment is dependent upon that teacher's knowledge of children's developmental understandings of key mathematics concepts.

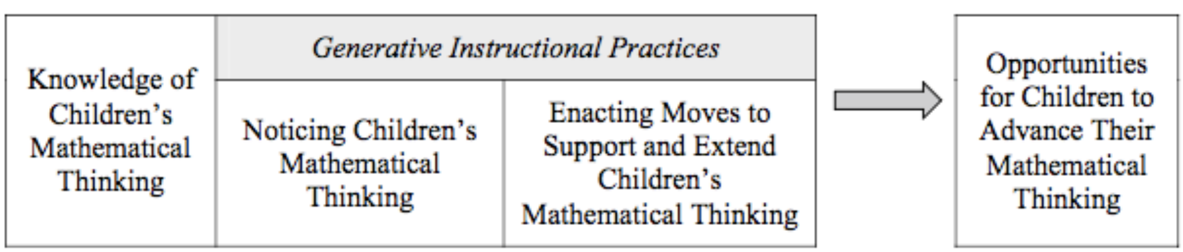

Figure 1: Framework for In-the-moment Noticing of Children's Mathematical Thinking

A significant volume of research has described this knowledge, identifying what students of a given age tend to know, think, and do when working on particular mathematics concepts. For instance, Fennema et al. (1996) identified a developmental trajectory that students in the primary grades tend to follow as they solve arithmetic problems.

Even if they have not studied such developmental trajectories explicitly, veteran teachers are likely to be familiar with what children of a given age tend to know, think, and do. For novice

Hodges, T.E., Roy, G. J., & Tyminski, A. M. (Eds.). (2018). *Proceedings of the 40th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Greenville, SC: University of South Carolina & Clemson University.

teachers, however, this knowledge it is likely to be less well-developed. As novices have had "the least experience with children's thinking" (Jacobs et al., 2011, p. 100), they are likely less aware of what is typical for children of a given age to know, think, and do mathematically. This raises some important questions. If novice teachers are lacking knowledge of children's developmental understandings of key mathematics concepts, are they capable of noticing students' mathematical thinking in-the-moment? And if so, what knowledge do they draw upon to support this noticing? The present study sought to answer the following:

1. To what extent do novice teachers notice students' mathematical thinking in-the-moment?
2. What knowledge do novice teachers draw upon to support them in noticing students' mathematical thinking in-the-moment?

Method

Setting and Participants

For this study, I recruited four early-career teachers from a public school serving students in grades 4-9. One teacher, Kerry, taught 4th-grade, while Taylor taught 5th-grade, Hannah taught 6th-grade, and Caroline taught 9th-grade (all names are pseudonyms). Kerry and Hannah were first-year teachers at the time of the study, while Taylor and Caroline were in their third year in the classroom. I purposefully selected these teachers because of their school's commitment to student-centered instruction. As opportunities to notice students' mathematical thinking in-the-moment arise as teachers interact with students, I sought to work with teachers in a student-centered school, where significant instructional time would be spent interacting with students.

Data Collection

Capturing video for discussion. Similar to Sherin, Russ, and Colestock (2011), I examined teachers' in-the-moment noticing by first capturing video of teachers' lessons then having them discuss moments from this video shortly afterwards. I used two cameras, a Drift Stealth™ and a GoPro Hero 4™. Teachers mounted the Stealth to the side of their head using a headband and triggered the camera to capture clips of their interactions with students in two of their lessons. I collected a second source of video using a GoPro mounted at the back of the room, as I was worried that teachers might forget to capture clips using the Stealth. Using an app, I viewed a livestream of teachers' lessons recorded using the GoPro and listened to audio of their conversations with students captured using a wireless mic that the teachers wore. As I watched the GoPro video, I tagged moments when the teacher interacted with students.

Post-lesson interview. Consistent with the procedure used by Sherin and colleagues, I asked teachers to discuss their videos in an interview shortly after their second lesson; the first lesson was solely for piloting camera gear. Between each teacher's second lesson and their post-lesson interview, I watched as many of the teacher's Stealth clips as possible, selecting those in which there was some evidence of students' mathematical thinking. I also referenced notes I had taken for the tagged GoPro moments, choosing those in which some mathematical thinking was on display. I chose Stealth clips and GoPro moments in this manner, as I worried that a more random selection would have resulted in a lack of noticing of student thinking, not because teachers were not capable of such noticing, but because there simply would have been less mathematical thinking to notice in a random selection of clips/moments.

In the interviews, I showed the teacher a still image from the start of each clip/moment then asked them the following: "can you walk me through what was happening at this point in the lesson?" When a teacher was not able to respond to this prompt, I played the video until they

Hodges, T.E., Roy, G. J., & Tyminski, A. M. (Eds.). (2018). *Proceedings of the 40th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Greenville, SC: University of South Carolina & Clemson University.

could. As soon as teachers were able to respond to the prompt, I stopped the video. This procedure was followed as it limited the amount of video teachers were shown, thereby reducing the likelihood that what they went on to describe was based on what they noticed in watching the video and not what they had noticed when the moment actually happened in the preceding lesson. I collected audio- and video-recordings of these interviews.

Data Analysis

Creating instances. I parsed the video of each teacher's post-lesson interview into instances, which consisted of all discussion by the teacher of a given Stealth clip or tagged GoPro moment.

Teachers' noticing. I next created two coding schemes: one for teachers' "attending" and a second for teachers' "interpreting" (Jacobs, Lamb, & Philipp, 2010). Every instance was assigned one of three codes for "attending": (1) evidence of attending provided, (2) lack of evidence of attending provided, or (3) not applicable. If a coder could describe the mathematical strategy of a student or group of students in some clip/moment based on what the teacher said, a level 1 code was assigned. When the teacher did not provide enough detail to make this possible, a level 2 code was assigned. When the teacher did not mention any mathematical strategy in a given instance, a level 3 code was assigned. A similar process was followed when coding "interpreting." Specifically, each instance was assigned one of three codes for interpreting: (1) evidence of interpreting provided, (2) lack of evidence of interpreting provided, or (3) not applicable. If in discussing a given clip/moment, a teacher mentioned what in particular a student or group of students understood (e.g., the student knows how to count by 5's), coders assigned a level 1 code. When the teacher instead made a broad claim (e.g., the student understands addition), a level 2 code was assigned. Finally, if the teacher made no mention of what a student or group of students understood mathematically, a level 3 code was assigned.

Teachers' knowledge. As teachers discussed clips/moments from their lessons, they not only attended to and interpreted students' thinking, but also referenced their knowledge of a range of things. I created a third coding-scheme describing the nine different types of knowledge that teachers referenced in their interviews.

Looking for associations between attending, interpreting, and knowledge. After all instances had been assigned a code for attending, a code for interpreting, and up to nine codes for knowledge, I looked for associations between the attending, interpreting, and knowledge codes. Specifically, I looked to see which types of knowledge were referenced most when "attending" was coded level 1, when "interpreting" was coded level 1, and when both were coded level 1.

Results

Novice Teachers' In-the-moment Noticing

Overall, the four teachers in this study were asked to discuss 49 instances of instruction. In 19 of these 49 instances, teachers provided evidence of attending (i.e., level 1 attending). Similarly, in 18 of these 49 instances, teachers provided evidence of interpreting (i.e., level 1 interpreting). Though evidence of attending was not always accompanied by evidence of interpreting, in 10 of 49 instances, teachers provided evidence of both attending and interpreting.

As an example of level 1 attending, consider the following comment made by one teacher, Kerry, in discussing an interaction she had with a student trying to solve 6×9: "So, I think what [she's] doing here is talking about ten groups of six, does that sound right? Or seven. One of the two. Like, [she's] doing ten groups then subtracting a group to get nine." Based on this comment, coders were able to describe the strategy of the student being discussed, a compensation strategy for multiplication (i.e., $6 \times 9 = 6 \times 10$, subtract 6). As such, coders determined that Kerry had provided evidence here of attending to the substantive details in the student's strategy.

Turning to interpreting, consider Taylor's comment below about an interaction she had with several students trying to place the fractions 4/5 and 3/4 on the number line:

> And, so, I think he was just … using that visual in his head, like, the four, four-fifths versus three-quarters. And then I asked them about if they were missing, they were both missing one piece and what that means, and they were able to say that the, obviously the one that's missing a fifth is a much smaller piece than the one missing a quarter … because it's split into smaller pieces.

Here, Taylor made a specific claim about the understanding of a group of students. Specifically, Taylor claimed that the students in this particular moment knew that 1/5 was a smaller piece than 1/4. As such, coders assigned a level 1 code for interpreting here.

Although teachers provided evidence of either attending or interpreting in a number of instances, this was not always the case. Indeed, in 8 of 49 instances, teachers made no mention of what a student or group of students did in solving a given mathematics problem, while in 18 of 49 instances, they made no mention of what students understood mathematically. In these instances, teachers instead discussed things like students being off-task, even though students' mathematical thinking was on display.

Knowledge Referenced When Discussing Moments of Instruction

Teachers referenced nine types of knowledge in discussing moments from their lessons. *Knowledge of an individual student* was displayed anytime a teacher referenced something in general that they knew about a student. As this knowledge was either mathematical or not, there were actually two codes for knowledge of an individual student. For example, in discussing a student in one moment from her lesson, Kerry commented, "she usually struggles in math, so she'll find the easiest way possible." As another example, when discussing a moment from her lesson, Taylor stated, "well, this one, … she's kind of a perfectionist." While Kerry's comment was focused on mathematics, Taylor's was not.

Knowledge of a group of students was displayed whenever a teacher referenced something they knew about a group of students. As an example, in discussing a moment from her lesson, Taylor stated, "this is the group that I went to first because, I, they're, they're the lowest…they're still really struggling with fractions." While Taylor here referenced knowledge of a group of students that was mathematical in nature, Hannah provided an example of this type of knowledge that was not mathematical, stating, "and the usual ones raised their hands."

Knowledge of the class was displayed anytime a teacher referenced something they knew about their class. As an example, consider the following comment made by Kerry when discussing a moment from her lesson on patterns in multiplication: "So, lots of them I noticed in their patterns, and in everything they do, assume that I can read their minds because they only put, like, half of what they're thinking and it's not enough information for me." Conversely, consider the following comment made by Hannah: "I have, like, a really gifted group and so, they tend to move very fast and they jump right ahead of many others, there's a large gap." The comment here by Kerry focused on the lack of detail her students provide in their mathematical work, so was deemed mathematical in nature, while the comment made by Hannah was not.

Knowledge of students was observed whenever a teacher mentioned something they knew about students in general. For example, consider the following comment made by Kerry in discussing her lesson: "'Cause some kids with subtraction just get, like, really stuck up, even though it is a smaller subtraction, they're like, 'muhhh,' and they get overwhelmed, so the

Hodges, T.E., Roy, G. J., & Tyminski, A. M. (Eds.). (2018). *Proceedings of the 40th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Greenville, SC: University of South Carolina & Clemson University.

addition really would be faster for them." By contrast, Kerry also discussed how she likes to let students work in the hallway because, "some kids really do need that quiet to focus." Hence, the first comment here was related to mathematics, but the second one was not.

Finally, *knowledge of a prior lesson or moment* was observed anytime the teacher referenced either a prior lesson or some moment that had occurred earlier in the lesson being discussed in their interview. For example, when discussing a strategy one of her students was using, Kerry, as if speaking to the actual student, said: "'I'm pretty sure you're using this strategy we talked about in class and that's really cool.'" Conversely, when discussing an interaction with a student about a lack of detail in his work, Kerry referenced knowledge of a similar moment from earlier in the lesson, stating: "Zack, when I was talking to him, … we were looking at his patterns, same thing, where I was just like, 'I don't, this isn't enough information, can you expand on that for me?'" In all cases when a teacher referenced knowledge of a prior lesson or moment, this knowledge was mathematical in nature.

Knowledge and In-the-moment Noticing

When teachers provided evidence of in-the-moment noticing, they referenced certain types of knowledge more so than others. Specifically, in 10 of the 19 instances when teachers' attending was coded level 1, teachers referenced *knowledge of individual students,* while in 9 of these 19 instances, they referenced *knowledge of a prior lesson or moment*. Similarly, in 6 of the 18 instances when teachers' interpreting was coded level 1, teachers referenced *knowledge of individual students,* while in 9 of these 18 instances, teachers referenced *knowledge of a prior lesson or moment.* In 3 of the 10 instances where both attending and interpreting were coded level 1, teachers referenced *knowledge of individual students*, while in 4 of these 10 instances, teachers referenced *knowledge of a prior lesson or moment*.

To illustrate how the knowledge teachers referenced seemed to support their in-the-moment noticing, consider the following comment made by Taylor in discussing an interaction she had with a group of students:

> This one, she's very, um, particular, like, she's, she's kind of a perfectionist, she wants to make sure everything's done well. And I think she was, she was, so, they had figured out which of the fractions, which were big–, larger than one, they had figured out which order they should go in, but they were trying to figure out where to place it on the number line. Um, and I think she was wanting to be, like, pretty exact of where it went.

In this comment, Taylor referenced non-mathematical knowledge she had of an individual student, specifically, that the student was "kind of a perfectionist." This knowledge seemed to set an expectation in Taylor's mind for what to then notice in the group's mathematical work, specifically, that this group would be quite precise in placing fractions on the number line. Indeed, shortly after providing the quote above, Taylor attended to the mathematical strategy used by the group of students being discussed, explaining that, rather than place the fractions 8/7 and 1 & 3/14 just anywhere to the right of 1 on the number line, the students converted 8/7 into a mixed number, thereby allowing for a more precise placement of these fractions:

> The, it was, like, one and two-four, they had figured out, they had, they had already found an equivalent fraction and converted it to a mixed number fraction, so I think it was 1 & 2/14 and 1 & 3/14 … I think there was 8/7, I think that they changed 8/7 to, so they figured out that it was 1 & 1/7, and then they changed it to 1 & 2/14. Yeah.

Hodges, T.E., Roy, G. J., & Tyminski, A. M. (Eds.). (2018). *Proceedings of the 40th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Greenville, SC: University of South Carolina & Clemson University.

Discussion

Better Than Expected

As this study demonstrates, novice teachers are certainly capable of noticing salient details in students' mathematical thinking in-the-moment. Existing literature, however, might suggest otherwise. Studies of novice teachers' noticing have found that, at least initially, early-career teachers tend to notice things like classroom management and behavioral issues more so than the substance of students' mathematical thinking (Star, Lynch, & Perova, 2011). Similarly, research examining teachers' noticing of students' mathematical thinking in particular has found that novice teachers tend to focus on the general features of students' strategies (e.g., that a student's work lacks organization) more so than the "mathematical essence of the [strategies]" (Jacobs, Lamb, & Philipp, 2010, p. 183). And yet, in 19 of 49 instances in the present study, teachers provided evidence of attending to students' mathematical thinking, while in 18 of 49 instances, teachers provided evidence of interpreting students' thinking.

These results are particularly compelling for two reasons. First, unlike previous studies of teacher noticing (Jacobs, Lamb, & Philipp, 2010), in the present study, teachers were not asked to describe what students did or understood mathematically, yet still spoke of such things in discussing their lessons. Second, this was a study of teachers' *in-the-moment* noticing, which scholars have both theorized (Sherin & van Es, 2009) and found (Dyer, 2013) to be particularly challenging for teachers. Given this, the task presented to the novice teachers in this study was quite demanding, making the extent to which they noticed student thinking all the more impressive.

So, what could explain why the novice teachers in this study did better than might have been expected in noticing students' mathematical thinking? In previous work examining novice teachers' noticing, teachers were asked to observe students who were not their own and who they had not actually taught themselves (Jacobs, Lamb, & Philipp, 2010; Star, Lynch, & Perova, 2011). As such, teachers in these studies had no knowledge of the students they were observing, the class they were in, or the prior lessons in which they had taken part. As a result, these teachers simply could not leverage such knowledge, knowledge that the present study suggests may be critical in supporting novice teachers' noticing of student thinking.

Mine Your Experience, There Is Knowledge There

This study aligns with existing literature that suggests that teachers' own classrooms are a rich source of knowledge. At present, significant efforts are being made in teacher education programs to prepare novice teachers for the many demands of the classroom. However, scholars have cautioned that no amount of such training can adequately prepare prospective teachers for these many demands (e.g., Ball, Sleep, Boerst, & Bass, 2009). Almost two decades ago, Ball and Cohen (1999) spoke of how "much of what [teachers] … have to learn must be learned in and from practice rather than in preparing to practice" (p. 10). The findings of the present study suggest that some of the knowledge that supports novice teachers' in-the-moment noticing is acquired in teachers' very own classrooms, with their very own students.

This is not meant to suggest that all teacher learning should be postponed until the novice teacher is in their own classroom. Rather, these results suggest that, with regards to in-the-moment noticing, it may be fruitful to prepare teachers to inquire into and acquire knowledge from the spaces in which they teach (Hiebert, Morris, Berk, & Jansen, 2007).

Concluding Thoughts

There were several exceptions to the "knowledge informs noticing" story told above. Indeed, in 2 of the 10 instances in which teachers provided evidence of both attending and interpreting, none of the knowledge types in my coding scheme were referenced. Also, there were instances when teachers called upon what seemed to be the most helpful sources of knowledge (i.e., knowledge of individual students, knowledge of a prior lesson or moment), yet did not provide evidence of in-the-moment attending or interpreting. While I present these cases here as counter-examples, they could also be regarded merely as evidence that the relationship between noticing and knowledge is simply not that straightforward.

Finally, it is important to note that the teachers in this study could well have relied on other, more tacit knowledge (Eraut, 2000) to support their noticing that they simply did not, or could not, share explicitly in their interviews.

References

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond and G. Sykes (Eds.), *Teaching as the learning profession* (pp. 3–31). San Francisco, CA: Jossey-Bass.

Ball, D. L., Sleep, L., Boerst, T. A., & Bass, H. (2009). Combining the development of practice and the practice of development in teacher education. *The Elementary School Journal*, *109*(5), 458-474.

Dyer, E. B. (2013). Investigating the relationship between teacher professional vision and classroom practices: A case of misalignment. In M. Martinez & A. Castro Superfine (Eds.), *Proceedings of the 35th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 988-995). Chicago, IL: University of Illinois at Chicago.

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology*, *70*(1), 113-136.

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*(4), 403-434.

Hiebert, J., Morris, A. K., Berk, D., & Jansen, A. (2007). Preparing teachers to learn from teaching. *Journal of Teacher Education*, *58*(1), 47-61.

Jacobs, V. R., Lamb, L. L., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal for Research in Mathematics Education, 41*(2), 169-202.

Jacobs, V. R., Lamb, L. L., Philipp, R. A., & Schappelle, B. P. (2011). Deciding how to respond on the basis of children's understandings. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 97-116). New York, NY: Routledge.

Jacobs, V. R., & Empson, S. B. (2016). Responding to children's mathematical thinking in the moment: An emerging framework of teaching moves. *ZDM Mathematics Education, 48*(1–2), 185-197.

National Council of Teachers of Mathematics (2014). *Principles to actions: Ensuring mathematical success for all.* Reston, VA: NCTM.

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

Sherin, M. G., & van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education*, *60*(1), 20-37.

Sherin, M. G., Russ, R. S., & Colestock, A. A. (2011). Accessing mathematics teachers' in-the-moment noticing. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 79-94). New York, NY: Routledge.

Star, J. R., Lynch, K. H., & Perova, N. (2011). Using video to improve preservice mathematics teachers' abilities to attend to classroom features: A replication study. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 117-133). New York, NY: Routledge.

Hodges, T.E., Roy, G. J., & Tyminski, A. M. (Eds.). (2018). *Proceedings of the 40th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Greenville, SC: University of South Carolina & Clemson University.