Teacher Noticing in Various Grade Bands and Contexts: Commentary

Brett Criswell and Rebecca McNall Krall

Abstract The chapters in this section explore professional noticing in contexts that include both middle and high school pre- and in-service teachers. The authors employ different theoretical and conceptual frameworks, and examine the professional noticing activities of their participants using different research methodologies. To try to tie together these different intellectual contributions, we present and provide initial considerations of six overarching questions related to this important field of scholarship. The hope is that readers will also consider these questions, and will reflect on the way the authors within this section address them as we work as a field to deepen our understanding of professional noticing.

Keywords Professional noticing · Purposeful reflection · Pedagogical content knowledge · Gestalt psychology · Inattention blindness

> *So Hilbert's strategy, one that we might do well to learn from, was to predict ignorance and not answers. He put no timeline on when the major problems might be solved, but nonetheless there are few mathematicians who would not agree that Hilbert's little speech at the opening of the 20th century was a positive influence on mathematics that effectively set much of the field's agenda for more than a hundred years.*
>
> —Stuart Firestein in *Ignorance: How it drives science* (2012, p. 46), referring to David Hilbert's speech at the Second International Congress of Mathematicians held in Paris, 1900

B. Criswell (✉) · R.M. Krall
University of Kentucky, Lexington, KY, USA
e-mail: brett.criswell@uky.edu

R.M. Krall
e-mail: rebecca.krall@uky.edu

E.O. Schack et al. (eds.), *Teacher Noticing: Bridging and Broadening Perspectives, Contexts, and Frameworks*, Research in Mathematics Education,
DOI 10.1007/978-3-319-46753-5_2

Framing

Firestein's book *Ignorance* suggests that it is not *finding answers* that drives science (or mathematics), but it is in fact *establishing ignorance* that moves the field (s) ahead. He points to David Hilbert's identification of the 23 most vexing problems of mathematics as proof of his central thesis (Hilbert's full speech can be found at http://www2.clarku.edu/~djoyce/hilbert/). Given the growth in research in the field of professional noticing, it seems appropriate to accept Firestein's assertion and follow Hilbert's model of how to address that point. As such, while chapters in this section generated many insights regarding professional noticing across contexts, we will focus the discussion on four significant questions that emerged from our review.

Question 1: What *Is* Noticing? And How Is It Different from/Related to *Reflecting*?

What is noticing? In her chapter, Males defines professional noticing by drawing on Mason's (2002) work, explaining that, "noticing is something that we do all the time, but in a profession 'we are sensitized to notice certain things,' (p. xi)," (p. 91). She asserts, "the ability to notice is often perceived to develop over time as it requires extended opportunities to focus on aspects of practice and make connections between teaching and learning," (p. 91). Krupa, Huey, Lesseig, Casey, and Monson elaborate on Mason's (2011) construct, referring to his notion of *awareness,* describing it as a consequence of noticing, the ability to direct teachers' attention toward relevant teaching events. In contrast, Floro and Bostic employ Luna, Russ, and Colestock's (2009) definition, which describes teacher noticing as "a means for teachers to engage in formative assessment practices because 'teachers must recognize students' thinking … as it happens and make … instructional choices in response to what they notice,'" (p. 76).

If "noticing is something that we do all the time," (Mason, 2002, p. xi), how is professional noticing as Luna et al. (2009) describe it different from noticing in general? Mason's (2002) construct suggests there may be generic skills of noticing that translate to all professions, while specific skills and coding schemes (Goodwin, 1994) demarcate noticing in specific professions. Could it be that professional noticing is analogous to the layers of an onion where the outer layers symbolize general skills of noticing and the inner layers represent the increasingly complex coding schemes salient to a profession?

This progression from generic skills to more specific coding schemes seems to correlate with the shift from outer attention – focus on the superficial features of that which is being examined – to inner attention – focus on the deeper underlying structure discussed by Dewey (Mason, 2011). Applied to teaching, this could be conceptualized as a shift from those things easily observed – student behaviors and

actions – to those things that must be meaningfully inferred – student thinking about problems and phenomena. Preservice teachers (PSTs) in several of the studies included in this section of papers demonstrated movement along this progression. For example, PSTs in Males' study tended to maintain a focus on outer attention, rather than on student thinking (inner attention). Krupa et al.'s study illustrated the difficulty secondary mathematics PSTs had in applying their abilities to attend to and interpret classroom events to formulate instructional responses that support student mathematical thinking. In comparison, PSTs in Teuscher, Leatham, and Peterson's study demonstrated that, with extensive experience analyzing videos for student mathematical thinking, they were able to attend, interpret, and respond to student thinking in the moment during student teaching.

Taken together these studies suggest a progression of professional noticing from general noticing skills to more specific skills for given contexts. Research is needed to determine whether there may be general skills that support noticing and serve as a foundation for more specific coding schemes characteristic to a profession and, if so, what such a "learning progression" for noticing looks like.

A related issue is, "How is professional noticing different from reflection?" In their chapter, Teuscher et al. reference Stockero's (2014) notion of *mathematical important moments* (MIMs). Although the authors do not explicitly define this notion, it is clear from the discussion that these represent significant events within classroom activity in which there are pedagogical opportunities for a teacher to respond to and build on students' thinking (Leatham, Peterson, Stockero, & Van Zoest, 2015). In this sense, then, this notion seems closely connected to the idea of *critical incidents*, which has been a focus of research on teacher reflection for over a quarter of a century (Farrell, 2008). If a goal of work in professional noticing is to help teachers be better able to recognize mathematically important moments (e.g., Stockero &Van Zoest, 2013), then it is necessary to explain how it is different from/related to assisting teachers in becoming more capable of identifying critical incidents in their reflective practice.

One way to distinguish between professional noticing and reflecting might be to suggest that professional noticing is directed toward the recognition of and response to key teaching events *in the moment*, while reflecting is more focused on making sense of such events *after the moment*. However, Teuscher et al. note that one of the features that distinguishes their work from that of Stockero (2014) is

> that [student teachers] applied a framework to the analysis of videos of lessons, the latter experience wherein we measure their noticing skills was based on real-time observations, where student teachers reported the details of their noticing without the ability to replay video in order to aid their analysis (p. 35).

Moreover, Schön (1983) described the difference between reflection-*on*-action and reflection-*in*-action, where the former indicated the capacity to reflect in retrospect and the latter the capacity to reflect in the immediacy of the moment.

This suggests that reflection and noticing could be conceived as a dialectic pair of processes that could be mutually reinforcing, indicating that professional noticing might help teachers better identify what to reflect on (attending) and assist

them in determining how to act upon the outcomes of the reflective process (deciding). Conversely, reflection could push teachers to more critically analyze their sense making within professional noticing (interpreting) to recognize when their biases and beliefs are impinging on those interpretations. It is crucial that future research empirically examines the possible relationships so teachers can be supported in developing synergy between these processes.

Question 2: What Are the Psychological Mechanisms of Noticing, and How Could Collaborations Between STEM Education Researchers and Educational Psychologists Elucidate These Mechanisms?

In the theoretical framework, Krupa et al. interconnect Goodwin's (1994) notion of *highlighting* with Mason's (2002) idea of *awareness* and Jacobs, Lamb, and Philipp's (2010) principle of *attending*. Further, Teuscher et al. begin their chapter noting that teachers must sift through the minutia of sensory data in order "to make in-the-moment decisions that will support student learning," (p. 31). They observe that while some expert teachers are able to monitor the complexity of the classroom, many teachers resort to cognitive tunneling (Miller, 2011). Implicit in these discussions is the recognition of psychological processes that underlie practices of professional noticing, and the potential value collaborations with educational psychologists could bring in investigating those processes.

In this vein, it seems important to remember that one of the main foci of Gestalt psychology since its inception has been in determining how humans perceive figure and ground (Koffka, 1935)—very much related to a notion of highlighting, awareness, or attending. In the area of perception, additional research on visual seeing and perception has also indicated that inattentional blindness (Mack & Rock, 1998) is common during high perceptual load conditions (Most, 2013). Schoenfeld (2011) asserts that teachers' orientations to teaching greatly affect their perceptions, and therefore attention, on specific events in the classroom. Gestalt psychology has helped to build understanding in such areas as object recognition in computers (Wu & Zhang, 2013), and in delineating the parallels between foregrounding and backgrounding bodily feelings, and pre-reflective and reflective bodily awareness (Colombetti, 2011). Furthermore, research on perception and inattentional blindness can help identify ways to make objects—or salient classroom events—more apparent while teachers are attending to other stimuli (Schnuerch, Kreitz, Gibbons, & Memmert, 2016). All these studies seem to hold potential insights for those trying to understand how teachers with various levels of experience and operating in different contexts (1) determine what to focus upon, (2) connect the action of the classroom to the desired learning outcomes for their students, and (3) use professional noticing to inform reflection in and on teaching episodes.

The importance of this second question also surfaced in Krupa et al.'s discussion of various examples of teacher training focused on professional noticing. These

authors cite four different studies as examples of what this training can look like: Fernández, Llinares, and Valls (2013), McDuffie et al. (2013), Schack et al. (2013), and Star and Strickland (2008). A review of these four articles showed significant differences in how this training was approached. Two of the studies had participants work independent of each other (Fernández et al., 2013; Star & Strickland, 2008); one had a mixture of independent skill development followed by discussion around professional noticing (Schack et al., 2013); and the last one used exclusively small-group and whole-class discussion (McDuffie et al., 2013). Another way of describing these differences is through a cognitive lens. Using this view, it could be inferred that the approaches of Fernández et al. and Star and Strickland adopted an individual cognitivist stance on the development of professional noticing capacities (Araujo, 1998), whereas McDuffie et al. operated from a social constructivist stance (Pitsoe & Maila, 2012), and Schack et al. used a structure that appeared to merge the two perspectives. It is critical to understand the psychological processes underpinning professional noticing in order to be explicit about how theoretical perspectives might inform the best design of teacher training in this capacity.

Question 3: What Should Teachers—and Researchers—Be Noticing, and What Is the Appropriate Process for Determining This?

In relation to this question, consider the foci of the four chapters discussed in this commentary. Krupa et al.'s analysis focused on secondary mathematics PSTs' journal reflections, which aligned with the three interrelated noticing skills (Jacobs et al., 2010), and were driven by instructions to summarize what the student understood and did not understand about solving linear equations and to describe what they would do next to advance the student's thinking. Teuscher et al. maintained a similar emphasis on journal entries of secondary mathematics PSTs using the prompt: "*Describe observed mathematical thinking where a student was either frustrated or appeared to have misconceptions …*" (p. 37). In comparison, Floro and Bostic's study focused on in-service teachers' professional noticing of student thinking around modeling with mathematics. Males adopted a broader focus of upper grade mathematics PSTs, investigating what they identified as noteworthy in videos of their peers' teaching.

Comparing the work of Krupa et al., Floro and Bostic, and Teuscher et al. to Males's study, there is a dichotomy between those who limited the purview of professional noticing to students' mathematical thinking and to Males, who extended it to include all aspects of the classroom milieu. Addressing the issue of what components of practice professional noticing should encompass is an important discussion for the field. The greater attention on practices and authentic problem solving outlined in the Standards for Mathematical Practice (Common Core State Standards, Initiative, CSSI, 2011) and the Next Generation Science Standards (NGSS, NGSS for Lead States, 2013) emphasizes the need for teachers to

focus on student thinking. However, in light of findings from her study, Males raises the question as to whether a change in context influences what PSTs notice. Is this to say that the scope of professional noticing needs to be adaptable to the different contexts in which it is studied? If so, this would create a great challenge to the field in terms of transferring research insights across different contexts.

It seems likely that, in order to address the issues raised in the last two paragraphs, it will be necessary for those working in the field of professional noticing to create a theoretical model of this construct in the same manner that Magnusson, Krajcik, and Borko (1999) did in association with *pedagogical content knowledge* (PCK). Such a model would help all who wish to use this construct both in research and in teacher preparation to better conceptualize what it is, and to understand how it is related to other constructs—including PCK. In doing so, it also would seem prudent to ensure that teachers' voices are part of the conversations around what professional noticing entails, to what aspects of classroom practice it should be applied, and discussion around what theoretical model best captures our understanding of professional noticing.

Question 4: What Methods and Data Will Allow the Field of Professional Noticing to Push Itself Forward and Answer [Some of] the Questions Posed in This Commentary?

Not surprisingly, there was noticeable variation in the research approaches presented in the four studies in this section. While all of the researchers coded data, the source of the data was varied: interview transcripts (Floro & Bostic), assessment responses (Krupa et al.), journal responses (Teuscher et al.), and video feedback (Males). The majority of the coding was based on a priori categories (Krupa et al.; Teuscher et al.; Males), although Teuscher et al. generated subcodes after an initial analysis of the data, and Floro and Bostic employed emergent coding. The codes themselves ranged from very broad categories—classroom environment, classroom management, tasks, mathematical content, and communication in Males's study—to the very specific categories of Floro and Bostic's investigation (use mathematical models appropriate for the focus of the lesson; encourage student use of developmentally and content-appropriate mathematical models; remind students that a mathematical model used to represent a problem's solution is a work in progress, and may be revised as needed). Only one of the studies was purely qualitative (Floro and Bostic). The other three investigations quantified the data in some way in order to make comparisons before and after an intervention (Krupa et al.), across PSTs with different research experiences around student mathematical thinking (Teuscher et al.), or to indicated changes in PSTs' noticing across two semesters (Males).

Although much was learned from these methodological approaches, we would like to consider how other ways of exploring the data might extend our insights into professional noticing. The use of subcodes by Teuscher et al. suggests one way it is possible to come to a deeper, more nuanced, understanding of the processes involved

in professional noticing. Levin and Richards (2011) have expanded this idea, developing levels of action for each of the components. If the validity of such levels can be demonstrated empirically in terms of describing differences in the way individuals engage in professional noticing, they might assist the effort of more fully articulating what this construct represents and the diversity of ways it is employed across contexts. Related to this, the analysis by Teuscher et al. was unique in that they examined relationships between the codes for the different parts of the process; this led them to identify four "types" of noticing: General observation and general interpretation, student mathematical thinking, student mathematical thinking and general interpretation, and student mathematical thinking and root interpretation. Further use of this approach would have two beneficial outcomes: (1) It would provide data that could support efforts at uncovering the cognitive mechanisms of professional noticing and (2) it would allow researchers to more thoroughly describe how individuals engage in the practice of professional noticing.

In discussing the interviews they analyzed in their study, Floro and Bostic note, "The goal of the interview…is to make sense of teachers noticing moments through their reflection on unique instructional moments" (p. 79). This statement highlights the ultimate goal of the work being done in the field of professional noticing: *making sense* of the ways teachers engage in this practice so as to better support their use of it to improve instruction. Given this goal, it is necessary to consider what might be missing from the approaches used by the researchers in this section pursuant to achieving it. One approach that was not utilized by any of the authors or in any of the research in this area that we have been able to locate, is that of *phenomenography* (Dall'Alba & Hasselgren, 1996). This approach has proven effective in coming to understand other phenomenon in education (e.g., Åkerlind, 2008), and it is likely that it would have value in making sense of professional noticing. Larsson and Holmström (2007) explain that,

> phenomenography is the study of how people experience, understand or conceive of a phenomenon in the world around us. The investigation is not directed at the phenomenon as such, but at the variation in people's ways of understanding the phenomenon (p. 56).

From this description, it is apparent that adopting a phenomenographic stance would incorporate teachers' voices in models of professional noticing, and produce more holistic descriptions of what this practice entails. Further, researchers would likely better understand *how* teachers see the processes involved in professional noticing, how they think about engaging in those processes, and look at how changes in teachers' actions around practice are linked to changes in students' thinking and learning.

Concluding Remarks

The authors contributing to the chapters in this section provided the field of professional noticing valuable insights across the contexts in which their four studies took place. For example, Males described how PSTs in her study tended to

focus on *teacher actions* rather than on *student actions* as they analyzed peer-teaching videos. She leaves us to ponder whether different contexts may offer different opportunities for the kinds of events that teachers notice. This underscores the effect context may have on what teachers notice in the classroom.

In a sense, the studies by Krupa et al. and Teuscher et al. offer comparative interventions for developing PSTs' capacity in professional noticing of mathematical thinking. Krupa et al. employed the use of a one-on-one student interview on mathematical thinking to build PSTs' capacity in this area, whereas Teuscher et al. explored how long-term video analysis of student mathematical thinking affected PSTs' capacity for professional noticing in their own instruction. Teuscher et al. asserted that long-term video analysis had significant influence on PSTs' professional noticing abilities in real time. In contrast, PSTs in Krupa et al.'s study demonstrated growth in attending and interpreting, but showed little change in responding to student thinking. These findings suggest a difference in the cognitive demands of the three components of professional noticing, as well as a need for a different approach for developing PSTs' capacity in the third component—deciding. Outcomes also indicate more remains to be learned about a holistic set of experiences that can enhance PSTs' capacity to engage in professional noticing.

Floro and Bostic's study explored in-service teachers' capacity in professional noticing. Two themes emerged from their investigation: teachers' abilities to notice students' struggles with structure within mathematical tasks, and their abilities to notice student struggles translating between representations while problem solving. These findings suggest that context can affect what teachers' notice. What remains to be explored is whether this important outcome was a function of the lesson content, the training of these teachers, the teachers' particular classroom experiences or other factors—and then to determine how to use that in preparing future teachers.

The set of studies found in this section present those currently working in and those coming to the field of professional noticing with a good foundation for exploring this fertile terrain. In order to ensure the most productive journey into the future of this field, it seemed valuable to map the territory by not only describing what these researchers *have done*, but also to give significant attention to what *needs to be done*. In this sense, the broad questions posed throughout this commentary are intended to function like Hilbert's questions posed to the mathematical community at the beginning of the twentieth century: as a roadmap toward a deeper understanding of professional noticing and how we can use it to improve teaching and learning.

References

Åkerlind, G. S. (2008). A phenomenographic approach to developing academics' understanding of the nature of teaching and learning. *Teaching in Higher Education, 13*(6), 633–644.

Araujo, L. (1998). Knowing and learning as networking. *Management Learning, 29*(3), 317–336.

Colombetti, G. (2011). Varieties of pre-reflective self-awareness: Foreground and background bodily feelings in emotion experience. *Inquiry, 54*(3), 293–313.

Common Core State Standards Initiative. (2011). *Common core state standards for mathematics*.

Dall'Alba, G., & Hasselgren, B. (1996). *Reflections on phenomenography: Toward a methodology?* (No. 109). Philadelphia: Coronet Books Inc.

Farrell, T. S. (2008). Critical incidents in ELT initial teacher training. *ELT Journal, 62*(1), 3–10.

Fernández, C., Llinares, S., & Valls, J. (2013). Primary school teacher's noticing of students' mathematical thinking in problem solving. *The Mathematics Enthusiast, 10*(1), 441–468.

Firestein, S. (2012). *Ignorance: How it drives science*. USA: OUP.

Goodwin, C. (1994). Professional vision. *American Anthropologist, 96*(3), 606–633.

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

Koffka, K. (1935). *Principles of Gestalt psychology*. London, U.K.: Lund Humphries.

Larsson, J., & Holmström, I. (2007). Phenomenographic or phenomenological analysis: does it matter? Examples from a study on anaesthesiologists' work. *International Journal of Qualitative Studies on Health and Well-being, 2*(1), 55–64.

Leatham, K. R., Peterson, B. E., Stockero, S. L., & Van Zoest, L. R. (2015). Conceptualizing mathematically significant pedagogical opportunities to build on student thinking. *Journal for Research in Mathematics Education, 46*(1), 88–124.

Levin, D. M., & Richards, J. (2011). Learning to attend to the substance of students' thinking in science. *Science Educator, 20*(2), 1–11.

Luna, M., Russ, R., & Colestock, A. (2009, April). *Teacher noticing in-the-moment of instruction: The case of one high school science teacher*. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching: Garden Grove, CA.

Mack, A., & Rock, I. (1998). Inattentional blindness: An overview. In A. Mack & I. Rock, *Inattentional blindness* (pp. 1–26). Boston: MIT Press.

Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources and development of pedagogical content knowledge for science teaching. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge: The construct and its implications for science education* (pp. 95–132). Dordrecht, The Netherlands: Kluwer Academic.

Mason, J. (2002). *Researching your own practice: The discipline of noticing*. New York: Routledge.

Mason, J. (2011). Noticing: Roots and branches. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 35–50). New York: Routledge.

McDuffie, A. R., Foote, M. Q., Bolson, C., Turner, E. E., Aguirre, J. M., Bartell, T. G., … Land, T. (2013). Using video analysis to support prospective K-8 teachers' noticing of students' multiple mathematical knowledge bases. *Journal of Mathematics Teacher Education*, 1–26.

Miller, K. F. (2011). Situation awareness in teaching: What educators can learn from video based research in other fields. In M. G. Sherin, V. R. Jacobs, & R. A. Philipp (Eds.), *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 51–65). New York: Routledge.

Most, S. B. (2013). Setting sights higher: Category-level attentional set modulates sustained inattentional blindness. *Psychological Research, 77*(2), 139–146.

NGSS Lead States. (2013). *Next generation science standards: For states, by states*. National Academies Press.

Pitsoe, V. J., & Maila, W. M. (2012). Towards constructivist teacher professional development. *Journal of Social Sciences, 8*(3), 318.

Schack, E. O., Fisher, M. H., Thomas, J. N., Eisenhardt, S., Tassell, J., & Yoder, M. (2013). Prospective elementary school teachers' professional noticing of children's early numeracy. *Journal of Mathematics Teacher Education, 16*(5), 379–397.

Schoenfeld, A. H. (2011). Noticing matters. A lot. Now what? In M. G. Sherin, V. R. Jacobs, & R. A. Philipp, *Mathematics teacher noticing: Seeing through teachers' eyes* (pp. 223–238). New York: Routledge.

Schnuerch, R., Kreitz, C., Gibbons, H., & Memmert, D. (2016). Not quite so blind: Semantic processing despite inattentional blindness. *Journal of Experimental Psychology: Human Perception and Performance, 42*(4), 459–463.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Star, J. R., & Strickland, S. K. (2008). Learning to observe: Using video to improve preservice mathematics teachers' ability to notice. *Journal of Mathematics Teacher Education, 11*(2), 107–125.

Stockero, S. L. (2014). Transitions in prospective mathematics teacher noticing. In J. J. Lo, K. R. Leatham, & L. R. Van Zoest (Eds.), *Research trends in mathematics teacher education* (pp. 239–259). Switzerland: Springer International.

Stockero, S. L., & Van Zoest, L. R. (2013). Characterizing pivotal teaching moments in beginning mathematics teachers' practice. *Journal of Mathematics Teacher Education, 16*(2), 125–147.

Wu, J., & Zhang, L. (2013, September). Gestalt saliency: Salient region detection based on gestalt principles. In *2013 IEEE International Conference on Image Processing* (pp. 181–185). IEEE.

http://www.springer.com/978-3-319-46752-8

Teacher Noticing: Bridging and Broadening Perspectives, Contexts, and Frameworks

Schack, E.O.; Fisher, M.H.; Wilhelm, J.A. (Eds.)

2017, XX, 536 p. 51 illus., 12 illus. in color., Hardcover
ISBN: 978-3-319-46752-8