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Scaffolding Responsive Ways of Seeing in Science Education

Brett Criswell
West Chester University

Anna Arias
Kennesaw State University

Josh Ellis
Louisiana State University

Lawrence Escalada
Northern Iowa University

Shelly Forsythe
Texas State University

Heather Johnson
Vanderbilt University

Jessica Riccio
Columbia Teachers College

ABSTRACT
In this article, a team of science teacher educators, focused on video-based examinations of pedagogical practices, and working across multiple contexts, share a tool that they have created to help pre-service science teachers evolve their capacities related to professional noticing. Their contexts include both smaller and larger private and public universities, and members of the team work with both elementary and secondary students in science education courses. The tool – the Professional Noticing (PN) Template – is tied to an associated protocol for analyzing video of science teaching in actual classrooms. Both the protocol and the tool are presented and unpacked for readers so that it would be easy to use both in their teacher preparation contexts. Previous articles in this journal that describe strategies and approaches to supporting professional noticing development are reviewed. Additionally, research that provides the rationale behind the structure of the protocol and the tool is discussed so that readers can dive further into this area of inquiry as appropriate. Finally, examples of the work provided by teacher candidates when engaging in the protocol and using the tool are presented to demonstrate the kind of thinking that they generate in future science teachers.

Keywords: professional noticing, professional vision, video analysis, teacher beliefs, teacher identity

Introduction

> *The scientist, the entrepreneur, the photographer, the coach: Each relies on the ability to notice that which previously seemed invisible to everyone else … Anybody interested in thinking creatively seeks (needs) to notice what has been overlooked or ignored by others, to get beyond distraction and attend to the world. Every day, successful **teachers**, doctors, lawyers, small business owners, and middle managers pick up on the subtle clues and details that sail past everyone else. (Walker, 2019, pp. x-xi, emphasis added)*

These words, found in the introduction to *The Art of Noticing*, remind us that this capacity – to *notice* – is essential to what individuals in all walks of life do to participate in their professions productively and creatively. As the book's subtitle suggests, the 131 strategies found within its pages are designed to help people "spark creativity, find inspiration, and discover joy in the everyday." Among the professionals called out by Walker in the passage above are *teachers*, and it is clear from the nearly 10,000 results under 'teacher / professional noticing' in Google Scholar, and the numerous books (e.g. Bell, 2022; Schack et al. 2017; Sherin et al., 2022) written on these topics, that education researchers and teacher educators have also come to recognize the importance of this capacity to the work in which teachers engage.

In this article, a team of researchers/practitioners representing six universities across the United States shares the details of a tool we have used in our contexts over the past year to support both elementary and secondary education majors, primarily within science methods courses, in developing their noticing capacity. We briefly discuss our team and contexts, then review pieces that have appeared in this journal on the topic of noticing, and expand on them to present some key ideas from the broader literature. Following that, we deconstruct our tool – the Professional Noticing Template (PNT) – that is found in Appendices A (older) and B (newer). As we undertake that deconstruction to explain its structure, we also provide examples from one of our classrooms of what pre-service teachers communicated to us through their noticings.

Conceptualizing Professional Noticing

The team behind this paper came together through participation in a project led by the National Board for Professional Teaching Standards (NBPTS). The project, which began in 2015 and ended in 2018, focused on determining best practices for using NBPTS's ATLAS video library (NBPTS, 2026) in science teacher education. The initial members of the team were part of a working group within the project that was focused on finding a framework to guide the use of video cases in science teacher preparation; our inability to locate one that met our search criteria resulted in the team developing our own framework (Arias et al., 2020; Forsythe et al., 2021). Once the project ended, the team continued to work together and has been doing so for a decade now. Our members are faculty at six universities found in the eastern, midwestern, and southern United States. The universities range from private to public, with most being larger in terms of enrollment. Members work with elementary and secondary [science] education students in both undergraduate and graduate teacher education programs. All of us recognize the potential of video-based examinations of practice – either of other teachers' or of candidates' own – as useful to supporting the development of key pedagogical competencies.

One of the key competencies we see as critical to responsive science teaching is variously referred to as *professional vision* (Goodwin, 1994; Sherin et al., 2008), *professional noticing* (Gibson & Ross, 2016; Jacobs et al., 2010), or *teacher noticing* (Chan et al., 2021; König et al., 2021). These represent more than just differences in terminology; they reflect significant differences in the conceptualization of the construct. For instance, while Goodwin (1994) described professional vision as consisting of the processes of highlighting, coding, and articulating representations, Jacobs et al. (2010) conceived professional noticing as involving the processes of attending, interpreting, and responding. Additionally, whereas the social construction of meaning was central to Goodwin's formulation of professional vision, those who utilize professional/teacher noticing tend to adopt an individual cognitivist stance (Santagata et al., 2021). Our stance leans toward the social constructivist end of the spectrum (Newman et al., 1989; Wertsch et al., 1995), as will be demonstrated by the protocol for video analysis tasks we present. However, given that the tool we describe – the Professional Noticing (PN) Template – is named based on that construct and has, at its center, a table designed around the components of professional noticing, we use that label to maintain consistency – and to define the construct based on the literature using the same label. Thus, we define *professional noticing* as a capacity that involves teachers being able to (a) recognize critical events in the classroom milieu to which to attend, (b) make sense of those events based on sound pedagogical logic and evidence-based reasoning, and (c) utilize the information obtained from attending to and interpreting critical events to inform decision-making around appropriate pedagogical actions.

The Significance of Noticing

Gegenfurtner and Stahnke (2025) note the recent expansion of research in the area of professional vision/noticing: "Literature searches in any electronic database reveal that the number of publications on how teachers see and perceive information in classrooms increases rapidly" (p. 1). Taking this further, Stahnke (2025) suggests that, as a result of the work in this field, "[a] general consensus emerged that professional vision or noticing are important aspects of teacher competence or teacher expertise. (p. 11) It seems reasonable to accept the notion that knowing what to pay attention to, how to make sense of what one has attended to, and then how to base instructional decisions on this combination of information would be crucial to the effectiveness of any science teacher. As such, it seems critical for science teacher educators to identify and implement tools such as the one we describe in this paper – tools that support the development of the capacity to notice meaningfully in novice science teachers.

Other contributors to this journal have acknowledged the significance of professional vision/noticing to science teacher preparation. Wang (2023) used Mason's (2011) conception of noticing, particularly his view that it often involves disrupting automatized ways of seeing and making sense of events. She coupled this with Tripp's (2012) *critical incident* framework to support the development of teacher candidates' noticing. Wang identified several ways that researchers and practitioners have scaffolded this development – such as the use of structured questions during group discussions (Ulusoy and Çakıroğlu, 2021) and sentence frames (Kalinec-Craig et al., 2021) – then shared her own scaffolding based on a critical-incident-noticing framework. Her tool shares similarities with the one we present in this paper, e.g., by explicitly prompting candidates to explain *why* they consider an event a critical incident.

Rogers et al. (2019) described a framework (Iterative Model Building, IMB) that incorporates cognitive interviews and lesson study, and that focuses on developing teacher candidates' ability to notice student thinking and to improve their capacity to ask questions that can draw out students' ideas. They shared two *stories of adaptation*, in which members of the authoring team described how they modified the use of the framework to their contexts: Julie's story involved applying the framework to a graduate course on mathematics education, while Ingrid's story entailed utilizing her modifications in an undergraduate elementary science and health methods course. Benedict-Chambers et al. (2017) discussed the use of rehearsal teachings to enable the evolution of teacher candidates' noticing capacities. They overviewed a suite of four tools built around the Engage-Explore-Explain (EEE) framework, with a specific focus on "help[ing] novices anticipate, notice and understand the logic of typical ideas students may have about specific phenomena" (p. 4). A key conclusion from their analysis of the impact of the tools was that scaffolds such as these may allow teacher candidates to notice key features of instruction, such as students' use of scientific practices, to which they might not otherwise attend. Barnhart (2022) also sought to focus teacher candidates on students' thinking, using the *Learning to Notice* framework (van Es & Sherin, 2002, 2008) towards a goal of having the candidates adopt a "student-centered, interpretive lens" (p. 3). An important aspect that Barnhart (2022) highlighted in discussing her approach is a four-stage cycle in which teacher candidates (1) experience a phenomenon-based activity as learners, (2) view a video of the activity being used in an authentic classroom (an opportunity for the candidates to utilize their noticing skills), (3) design and enact a lesson based on the activity in field placements, and then (4) analyze the enactment (a second opportunity to utilize and hone their noticing skills).

McCausland and McDonald (2023) emphasized the noticing of the teacher *educators* rather than the candidates. Specifically, in their attempts to support their teacher candidates in implementing equity-oriented ambitious science teaching, they had a targeted concern with seeking "to identify how our racialized identities influenced what we noticed and how we addressed our noticing" (p. 4). While this is different than our focus in this article, it does align with our concern for Mason's (1998) levels of awareness in our own work, recognizing that his broadest (or deepest) level – *awareness-in-counsel* – is crucial to those – like teacher educators – tasked with assisting individuals in developing at the other two levels (*awareness-in-action* and *awareness-in-discipline*, the latter of which corresponds to professional noticing).

Cumulatively, these articles give the bulk of their attention to applying noticing to live acts of teaching (e.g., rehearsal teaching) and to focusing candidates on student thinking (the *what* of noticing). Our discussion that follows attends to the application of noticing to video cases (although our tool could be applied to live teaching) and to the general development of noticing (the *how* of noticing). We take a deep dive into a single instrument to fully unpack its structure and nuances. Our goal in doing so is to support science teacher educators in deepening their awareness-in-counsel so that they can be “sensitive to what others require in order to build their own awarenesses-in-action and -in-discipline” (Mason, 1998, p. 256).

Intervention Context: Implementing the Professional Noticing Template

While all members of our team utilize the tool – the Professional Noticing (PN) Template – for supporting noticing in their work with pre-service teachers, here we describe the context and provide examples from just one of our members’ classrooms (the lead author). This enables a cohesive discussion and direct comparison across the examples presented. The lead author teaches elementary and secondary science methods courses at a large public university in the eastern United States. The development of professional noticing/vision capacities in pre-service teachers is an integral part of all education courses that he teaches, but the application to the elementary science methods course is the focus of the current discussion. The elementary science methods course at this university is usually taken during the candidates’ junior year, lasts 15 weeks, and *does not* include a field experience component. Typically, classes have 32 students, and in the semester from which the examples are drawn, the 32 students were organized into eight working groups of four students each. Details of the video task protocol are presented in the next section; here, it is important to summarize the four videos chosen for analysis. All four videos are found in the ATLAS video library, discussed earlier. Table 1 below summarizes information about the videos.

Table 1
Information about the Video Cases Used in the Elementary Methods Course

ATLAS Case # and Title	Grade of Students in Video	Segment of Video Focused on	Brief Description of Action in Video Segment
1360 -- Investigating the Properties of Solids, Liquids, and Gases	1st – 20 students ages 6 – 8 with 2 ELLs; math-science integration in class	First 8:00, but deeper look at 4:30 – 6:20, 6:30 – 7:45, and 10:30 – 12:10	In this ice balloon investigation, students are discussing with the teacher the color and the placement of a balloon while ice inside the balloon was melting
693 -- Practicing Communication Skills While Investigating Matter	1st – 24 students with a broad range of reading levels and 8 ELLs	From 11:20 – 16:24	After a review on communication skills, students worked in pairs on a computer activity in which they had to make an argument for whether a material was a solid, liquid, or gas
1841 -- Synthesizing Thinking on Seed Germination	6th – General science class with 26 students including 7 ELLs and 3 IEPs	From 9:59 – 16:46	Even though this is 6th grade, the science content was appropriate because students were proposing ideas about what seeds need to sprout then discussing the ideas
2031 -- Modeling the Water Cycle Within a Closed System	4th – Gifted class of 20 students with 12 boys and 8 girls; 4 boys with ADHD	From 2:00 – 5:43 or 5:44 – 9:32 (assigned by table teams)	Even though the title suggests a focus on the water cycle, these segments involved students trying to make sense of plant growth in a closed system

A couple of points should be made about this list. First, other ATLAS videos (e.g., cases 619 and 675) were examined in the course, but the four cases in the table used the entire analysis protocol to be subsequently described. Second, while cases were chosen first and foremost for pedagogical considerations, an attempt was made to have the science content in the videos parallel the science content being explored in the methods class, which is why the content of the first two videos was *matter,* and of the second two was *plant growth*.

An Excursion Through the Protocol and the Tool

In their systematic review of the literature on the use of video in teacher education, Baecher et al. (2018) identified four types of *protocols* used in the studies, ranging from *highly structured* to *unstructured*. Our own protocol has elements of a highly structured format, as the Professional Noticing (PN) Template includes "reflective writing tasks with set prompts" (p. 204). However, it also has elements of a responsive format in that we "use [of] a generic set of interactional norms but then depend[ed] on the facilitator to respond in the moment to teacher [candidate] contributions" (p. 204). That range of features will become more visible as we unpack the protocol in the paragraphs ahead. Further, Baecher et al. delineated seven *modes of engagement* (pp. 201-202). We utilize at least two of those modes in the protocol for our video tasks: group discussion and reflective writing.

The features discussed above are embedded in a four-step analysis and discussion/reflection process that we overview in the sections below. For each of those steps, a portion of the PN Template will be presented in chunks corresponding to the associated segment of the protocol; the complete Professional Noticing Template is found in Appendix A.

Protocol Segment 1 – Individual Analysis with the When, Why, What Table and Prompts

The videos in the ATLAS library tend to be 15-20 minutes long, so they do not usually capture the entire lesson. Nonetheless, they often represent uninterrupted chunks of teaching and learning, and usually involve segments where students are actively engaged in the learning process. When a video analysis is scheduled in a class, the teacher candidates are asked to watch the video beforehand. Specifically, they are instructed to watch the entire video once through to get a holistic picture of the learning experience, and then to focus on a specific segment for individual analysis. As shown in Table 1, column 3, the focus segments are 4 to 8 minutes in length. While examining the focus segments, teacher candidates are directed to complete the 'When, Why, What' (WWW) table and respond to the two prompts under it, both on p. 1 of the PN Template. Figure 1 presents those two parts of the PN Template.

Figure 1

Page 1 of the Professional Noticing Template – the WWW Table and the Two Prompts

A. **When, Why, What** (completed individually): Identify 3 – 5 key events in the video that catch your attention. Note WHEN each event happened (time stamps), then share WHY the event caught your attention and WHAT you noticed in the event:

WHEN: Time Stamps (X:XX - Y:YY)	**WHY**: This event initially caught my attention because (e.g., it was surprising, it was unique, it reminded me of something I experienced, etc.) …	**WHAT**: I noticed (saw, heard, sensed, etc.) these things happening in this event (i.e., provide details of the actors and their actions) …
[1]		
[2]		
[3]		
[4]		
[5]		

1. Reflect on the events you chose and identify any personal experiences (in school, in life, etc.) that may be similar / connect to those events. Describe at least one of those experiences and the connections that you made to the events chosen.
2. Take at least one of the events you described above and think about how someone else might have seen it differently in terms of why it was important and / or what happened in the event. Explain how and why someone else might look at it differently than you did – and try not to *challenge* this different perspective you envision, just *consider* it.

Above the WWW table is a statement that overviews what candidates should be doing in order to appropriately fill in the table: (a) Identify 3 - 5 key events, (b) provide timestamps for *when* the events happen, (c) explain *why* they attended to the event, and (d) describe *what* happened within the event. The meaning of 'key event' is discussed with candidates before the first video analysis using ideas related to Tripp's (2012) notion of *critical incidents*, although that particular terminology is not used. The choice of suggesting that candidates identify 3 - 5 events does not have an empirical basis, but an intuitive one: That seemed like a number that would force candidates to think carefully about what they consider to be really significant events, and ensure that they would be likely to provide sufficient detail in the row for each event. Candidates are encouraged to add rows to the WWW table if they identify more than five key events.

The When column does not need much unpacking, except to underscore the importance of having candidates note the time of the event for reference purposes during subsequent small-group and whole-class discussions. As we are proponents of Goodwin's (1994) view that coming to 'see' in a shared way is a social achievement, we recognize that it is crucial for candidates to be able to reference timestamps to determine whether they agreed on what the key events were, why they are significant, and how the events are described and interpreted. It is also worth noting that the model for entering timestamps in the table (X:XX - Y:YY) is meant to prompt candidates to think about the duration of an event. Candidates often begin by identifying a single action or piece of talk as an event, and then consider whether events might be more properly understood as interactional outcomes between individuals in the video. Inevitably, a candidate will ask if it is okay for an event to involve such an interaction and, therefore, a longer stretch of time, and we have a class discussion about that consideration.

The Why column requires more thorough unpacking. In an article critiquing the empirical and theoretical work being done in professional noticing, Scheiner (2016) criticized the field for having thoroughly examined *what* teacher candidates notice, but having given little attention to *why* they noticed what they did. Beyond the importance to the research enterprise to understand why candidates do or do not see an event as significant, it is crucial to the social construction of professional vision within the classroom community to have candidates explicitly consider and explain this. Having candidates do this in their individual analysis allows them to bring this consideration into the small-group and whole-class discussions that are to follow.

Wang (2023) also has candidates consider and explicate why they paid attention to events, *after* they have described the event and *while* they are engaging in meaning-making about it. We purposely chose to place the Why column before the What column with the goal of getting the candidates to discuss the factor that made them attend to the event at the very moment they did so. Our hope is that this would give us the clearest, rawest understanding of what guides the attention of our teacher candidates. The stem ‘This event initially caught my attention because …’ is included in the column heading to focus candidates on this aspect. For those using this protocol, it is worth having conversations about the reasoning candidates share in the Why column, particularly patterns in that reasoning. We have found that some candidates regularly pay attention to events because they are *similar* to learning experiences they have had, while other candidates focus on events that are *different* from their own learning experiences. We discuss the value of attending to both kinds of events so that candidates can more effectively develop a broader repertoire of pedagogical practices.

After candidates discuss Why they attended to the event, they are asked to describe What they noticed in the event. The stem provided is ‘I noticed (saw, heard, sensed, etc.) these things happening in this event …’ and it has two critical features: (a) the parenthetical that encourages them to draw on all of their senses for the process of attending – not just sight and (b) the concern for the phenomenology of the event – the things happening. The latter is intended to initiate a shift towards more objective descriptions, away from inferences, judgments, and evaluations (Li, 2024; Mitchell & Marin, 2015). It also allows candidates to consider what details they noticed in the events as compared to what details others noticed as they share in their small groups. The AID table on page 2 of the PN Template also ask candidates for the description of what happened in the event, and comparing their individual noticings within the group supports the development of the candidates’ professional vision.

An example of what can be learned by a science teacher educator from the Why entries comes from the first video analysis around ATLAS Case 1360, in which students in the video investigate how the color and location of a balloon impacts the melting of ice inside of it. Candidate AA, a member of Team 4, stated, “This event caught my attention because the student was forming his argument as to why he believed sand was solid when student 1 asked him why he agreed. Both students state that sand is solid and make a connection to a personal experience they have had with sand.” This entry suggests that AA attended to this event because she recognized (a) the engagement of a student in a science and engineering practice (arguing from evidence) and (b) the student was forming the argument from a thing in his personal experience.

In the second video analysis, ATLAS Case 693, candidates had a chance to focus on student thinking as students discussed whether various materials were solids, liquids, or gases. In her What entry, candidate KO from Team 6 noted, “In this clip of the video, the partner shows her active listening skills by making eye contact and acknowledging how she agrees with what her partner says. She further connects to the example by making her own connection. She believed the picture looked like when you make hot chocolate and it lets out steam …” While this is not the full entry, it demonstrates how the candidate is paying attention to both the content of the students’ thinking and also to the way the students are interacting with each other.

One of the recurring problems in the WWW Table is that candidates sometimes entered very similar information in the Why and What columns, with the Why entry in certain cases just being an abbreviated version of the description of What they noticed in the event. To address this situation, we have modified the information provided in the Why column heading and the stem to make it clearer that they need to explain the reason for attending to the event. The modified version of the PN Template, with several tweaks, is in Appendix B.

For the individual analysis prior to class, candidates also need to respond to the two prompts below the WWW table, as shown in Figure 1. The first prompt (‘Reflect on the events you chose and identify any personal experiences (in school, in life, etc.) that may connect to those events …’) was developed to encourage candidates to consider how prior experiences – and the beliefs associated with them – shape the way they notice (Meschede et al., 2017). The idea is that having candidates explicitly reflect on these factors supports them in surfacing their experiences and beliefs throughout the video analysis process. The second prompt (‘Take at least one of the events you described above and think about how someone else might have seen it differently …’) was designed to promote perspectival shifts that could support candidates in reconfiguring their way of seeing the action in classrooms. It is also intended to promote the metacognitive skill of recognizing the perspective they are taking while noticing, and a willingness to consider other perspectives (Xu et al., 2019).

An example of a candidate response to prompt 1 comes from the first video analysis case, in which students in the video were exploring how the color and placement of a balloon affected the melting of ice within it. Candidate RG from Team 6 stated,

> The first observation I made was about the teacher calling the students scientists. I feel that when I was in elementary school, some of my teachers would mention it occasionally, but not enough. Students should be called scientists more often, and not once in a blue moon. I think it is so beneficial to make students feel and believe that they are scientists.

It is significant that RG drew on her own experience to recognize the ways that teachers (and other students) can impact the science identity of students in the classroom by the labels they use (or don't use) for them. She was fully explicating her belief in this regard and tying it to the impact on students' self-efficacy in relation to science and science learning (Sandrone, 2022).

An interesting response to prompt 2 came from candidate LS of Team 5 in video analysis 3. The video is one in which students share their ideas about what plants need to grow, and LS discussed an event to which she attended that involved an intriguing analogy:

> I think someone could interpret the teacher asking the student to elaborate on their sunlight is 'medicine for a plant' idea as confusing for other students. I think that this is a great way for students to hear a different perspective on the concept, which could help them understand fully. Many students learn more when they are learning from each other, something that I really enjoyed seeing in this video.

It is important that this candidate recognized the uniqueness of the idea being shared by the student, and that others might see the teacher's request for the student to elaborate on it as possibly sowing confusion in classmates. These different ways of interpreting the event provide good fodder for later conversations in the process. It is also important to note that what LG wrote in the second and third sentences in this response was, in a sense, her pushing back on this alternative perspective. This was not an uncommon occurrence for candidates to suggest why their original perspective / interpretation was superior to the alternative. Because of this, additional text has been added to the prompt for future candidates, reminding them that the goal of this prompt is to *consider*, not to *challenge*, the different perspectives that one can imagine.

Protocol Segment 2 – Small-Group Analysis & Attending, Interpreting, Determining Table

On the day of the video analysis, candidates are reminded that the goal of these tasks is to improve their ability to focus on key events happening within classrooms, make sense of these events, and think about how to respond instructionally to them. They are asked to complete part or all of the AID table (see Figure 2 below) in their table teams (of four candidates). Candidates are encouraged to share the key events they identified through their individual analysis, agree on what the most significant events were (and why), and then begin filling in a single AID table for their team; it is valuable to suggest they fill in the table *after* talking through the events so that completing the table becomes secondary to the conversations. In the first and second video analyses, the instructor usually limits the candidates to completing the Time Stamp, Attending, and Interpreting columns, and then ideas related to the Determining column are considered within the whole-class discussion (Protocol Segment 3); in the latter video analyses, candidates are asked to complete the entire AID table during their small-group analysis work. A single member of the group fills in the table and submits this part of the PN Template for their team.

Figure 2

Page 2 (Part A) of the Professional Noticing Template – the AID Table

Time Stamp (X:XX - Y:YY)	Attending: What is happening in the event related to the learning experience? What was said, done, written, etc. in this event – and by whom? [Description – an *account of* the event *free of evaluation / judgment* and *sufficiently detailed*]	Interpreting: Why did the actors say and do what they did? How can we explain what the teacher and students do in relation to the learning that is happening? How can we describe student under-standing and/or participation in learning?) [Sensemaking – *how* & *why* of the event]	Determining: What evidence is there of meaningful teaching and learning in the event? What are some other things you might have considered doing as the teacher in the event to best support learning for all students present? [Evidence & Alternatives]
#1			
#2			
#3			
#4			
#5			

While the candidates are engaging in the small-group analysis, the instructor circulates around the room with two objectives in mind: (1) support the candidates in the development of their noticing skills and (2) gather information about what they are attending to and how they are interpreting those events to seed the whole-class discussion as appropriate. With regards to (1), the instructor often checks with teams as to whether they reached consensus on the key events – and what criteria they were using to identify such events, reads their entries to ensure that they are providing objective descriptions in Attending and evidence-based statements in Interpreting, and pushes candidates to make connections to teaching science equitably, a theme of the course.

In unpacking the structure and text of the columns in the AID table, we want to consider the components holistically first. Scheiner (2021) has criticized the work within professional noticing for treating the component processes as either independent or unfolding in a linear fashion, instead of being interrelated and unfolding organically. While we do agree with the concern Schreiner has raised, we have found, for the purposes of scaffolding and honing candidates' noticing skills, that it is useful to have them separate out the processes in the way that the table supports. In fact, when candidates are first learning to notice, we might have them complete only the Attending column (as the lead author does in an introductory education course) or both the Attending and Interpreting columns (as done in the elementary methods course). Ideas borrowed from Baecher (2020) and Tishman (2018) are used to build candidates' understanding of the need to separate observation (attending) from inference (interpreting), and to slow down the process of observation to ensure it is thorough and objective.

The text in the column headings for A, I, and D is designed to delimit what each component represents, provide tips for creating entries that match the intent of the component, and connect the components to each other. For instance, the Attending text, which is designed to parallel the What column text in the WWW table, defines this component as being about ‘what is happening in the event’, indicates that candidates should draw on multiple senses, and encourages them to generate entries that are ‘free from evaluation’ and ‘sufficiently detailed.’ The Interpreting text distinguishes the content of this column from that of the Attending column by noting that these entries should focus on the *how* and *why*, as opposed to the *what*. The text further encourages the candidates to focus on student understanding/thinking, and to consider the reasoning behind teachers’ actions. Finally, the Determining column provides space to evaluate the effectiveness of what happened in the event, but only with supporting evidence. Just as importantly, the text in this column asks candidates to provide alternative actions that might have been undertaken, particularly by the teacher; this aspect of determining aligns with Levin et al.’s (2013) suggestion to support teacher [candidates] in developing a *menu of possibilities* and also with Santagata and Yeh’s (2016) *proposing improvements* component of their noticing framework. It is important to note that, with reference to the text describing the need for candidates to provide alternatives, the pronoun ‘you’ was purposefully chosen to get candidates to start imagining themselves making instructional decisions (Delamarter, 2019).

As an example of how the entire process was represented in the entries of the candidates, we share the complete AID entries for Team 5 in video analysis 4 – ATLAS Case 2031, in which students were conducting an investigation of plant growth in a closed system. For the Attending response, the team wrote, “The teacher sat down with the group and was discussing the types of measurements they wanted to take during the experiment. She reminded the students of wanting to measure the height that the wheat would grow and if the weight would change during the process.” While this entry was focused on what the teacher was doing, it was a key event because the teacher was supporting students in engaging in the science and engineering practices. For the Interpreting response, the team stated that,

> The teacher was making sure that the students knew what they were supposed to be measuring during the experiment as well as what they were expecting to happen to the closed system during the experiment. The teacher also allowed the students to measure the weight due to the student bringing up questions about the measurement of the plant. The student showed their curiosity on the measurement of the weight, and the teacher allowed them to add this measurement onto their already determined measurements.

This entry meaningfully interpreted what the teacher was doing relative to supporting the students engagement in the SEP of planning and conducting investigations, but also included an interpretation of the impact of this on students’ scientific curiosity. The aspect it does not describe to any significant extent is what these observations indicate about student understanding of the science concepts being explored in the investigation. This is something we have regularly found that we need to push the candidates in the elementary methods course to focus on more.

For the Determining entry, the team suggested that,

> Instead of using teacher-led discussion, the teacher could have allowed the students to communicate with each other on their thinking about the process. She could have got the conversation started and asked a question to try to facilitate a talk move with the students. A positive of this approach was that she allowed the students to measure the weight of the plant, even though she knew that the weight of the plant wouldn't change. The student wondered about it, so she allowed the students to explore if the weight of the plant would change or not.

The team begins this entry by immediately proposing an alternative action that could be taken by the teacher, and justifying why that action might have been more effective. They also highlight what was effective about what the teacher actually did, noting that by making her specific instructional choice, she allowed the students to carry out a particular measurement even though she knew the outcome was not what the students were expecting.

Protocol Segment 3 – Whole-Class Discussion & the Prompts Beneath the AID Table

Perhaps the most critical part of the video analysis is the whole-class discussion that follows the small-group analysis. As we conduct these discussions, the candidates are informed that this is *their* conversation: the instructor will step back and allow them to talk with each other about what they noticed and thought. To prepare them to talk with each other in this way, the instructor typically runs at least two *science talks* (Gallas, 1995) with the class prior to the first whole-class discussion. The instructor reminds the candidates that (1) they are to listen critically to what each other says, (2) build on and challenge each other's ideas as appropriate, (3) use the video and the PN template as evidence to back up claims, (4) work towards common understandings of effective [science] teaching practice, and (5) maintain the conversation by calling on subsequent speakers. With regards to (2), they are given three questions to consider as they listen to others talk: Do I fully understand what the speaker is saying?; Can I connect to or build on what the speaker is saying?; Do I agree/disagree with what the speaker is saying? The instructor takes notes on a whiteboard, summarizing the key idea(s) from each speaker. After candidates have exhausted the conversation, the instructor will summarize critical points made, elaborate on some, and play devil's advocate regarding others (van Es et al., 2014).

Once the whole-class discussion is completed (usually 15 - 20 minutes), candidates are asked to respond to the prompts under the AID table: (1) In what ways did your thinking about what was important, how to describe events in the video, or how to interpret those events change from your initial viewing through the small-group and whole-class discussions?; (2) What were your key take-aways from the overall video analysis task in terms of effective teaching practices?; (3) Following the video analysis, what do you think equity in the classroom 'looks like' and how can teachers support equitable learning experiences? How did the discussions around the video analysis task impact your thinking about equity?; and (4) Reflecting on the overall video analysis experience, what beliefs – about teaching, equity or life in general – do you think influenced the things that you focused on, how you described them, and how you made sense of them? Often, to make sure they provide more meaningful responses, they are only asked to respond to half of the prompts. While the directions in the PN Template indicate that these responses should be done on an individual basis, the instructor has often had teams complete these together to continue building the social construction of understanding.

The four prompts each have a significance towards our team's goals in conducting these video tasks: (1) Prompt 1 (key take-aways) is designed to always connect these activities back to the main goal of determining effective teaching practices; (2) Prompt 2 (thinking change) is focused on having candidates share about changes in their thinking/perspectives brought about by the process, (3) Prompt 3 (equity) is included to maintain the focus on equitable science teaching found in the course and to make more concrete how that can be achieved; and (4) Prompt 4 is the partner to Prompt 1 under the AID table, both geared towards getting candidates to surface and examine their beliefs about teaching equitably and effectively.

This response from Team 8 about how the class discussions impacted the candidates' thinking about equity is representative of the kind of outcomes the video tasks produced:

> These discussions can lead to more informed, compassionate, and effective teaching practices that equip us to support equitable learning experiences for all students. Teachers can support equitable experiences in the classroom by valuing all student ideas and background experiences/knowledge in the classroom. Videos and discussions can also highlight the importance of culturally responsive teaching. As teachers, we can learn about the need to incorporate students' cultural backgrounds into the curriculum, build relationships that honor students' identities, and create a safe, welcoming space for all learners. By discussing these ideas, teachers might be more encouraged to reflect on their own biases and think critically about how their teaching practices impact the equity of their classrooms.

Discussion

In a recent book chapter, Sherin et al. (2024) stated, "In defining 'core practices' in K–12 mathematics teaching, Jacobs and Spangler (2017) positioned teacher noticing as a core practice central to the work of high-quality teaching" (p. 32). We believe this assertion applies equally well to K-12 *science* teaching. Based on this belief, our team has spent over a decade thinking about and researching useful approaches for supporting the development of our K-12 science teacher candidates' noticing skills. In this article, we have shared one of our main tools in this regard – the Professional Noticing Template – unpacking its structure, providing an overview of a protocol for its use, and offering examples of candidate thinking generated from it. Utilizing the tool and the protocol that supports it requires a significant time commitment. Beyond the time candidates must put into completing the individual analysis outside of class, the in-class components – small-group discussion, whole-class conversation, and closing reflection –

generally require ~45 minutes. This may be untenable in certain contexts, and so it is possible to abbreviate the process by, for instance, removing phase 2 (the small-group discussion) and going directly into the whole-class discussion. Whatever time is spent on this is worth it.

As noted earlier, our team members have used this tool and the accompanying protocol across a number of different contexts. Included among those contexts is their use in secondary science methods courses. We have found the tool and protocol work equally well with secondary science candidates, with one main difference being that these candidates tend to naturally focus more on the content of students' (in the video) thinking. Additionally, we have applied the tool in limited ways to videos from the candidates' own teaching activities within field experiences; this is an aspect of the tool's use that we are still refining. For us, these video-based examinations of practice are invaluable as a formative assessment tool: We truly gain insight into the extent to which candidates apply pedagogical strategies discussed in the methods courses to these video tasks. Moreover, we recognize significant value to these tasks in helping our pre-service teachers learn how to 'see' and 'talk about' teaching practice. We hope that others will find this a useful tool in their own work with science teacher candidates, and, if they do, perhaps share with us what they are noticing when they use it.

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