# Scaffolding Prospective Teachers' Development of Noticing in Video-Based and Authentic Classroom Settings

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## Abstract

As an important aspect of teacher expertise, noticing skills need to be learned and practiced in teacher education programs. Although noticing literature has reported on the effectiveness of videos with associated scaffolding structures and the significant role that practical experiences play in teachers' development of noticing skills, research on ways to support prospective teachers' noticing in both video-based and authentic classroom settings in the field of science education is scarce. Building on teacher noticing research and the critical incident framework, this article describes a model that engages a group of prospective elementary teachers in the practice of noticing first in a 2-week, online, video-based training module and then in dynamic and complex classrooms when they attend a practicum associated with a science methods course. Detailed descriptions of the model, prospective teachers' learning outcomes, and thoughts and considerations for implementing the model are shared. Differences between prospective teachers' noticing journal entries prior to the video-based training module and immediately after, along with their noticing patterns in the practicum classrooms, show the development of prospective teachers' noticing skills during the semester. Factors that were found to impact prospective teachers' noticing in video-based and authentic classroom settings include: (a) using the adapted critical incident framework as a scaffolding guideline, (b) providing continuous feedback on prospective teacher noticing journals, and (c) having opportunities to observe science instruction in practicum classrooms.

### Introduction

Effective teaching is a complicated practice that requires teachers to respond to some events while disregarding others to actively monitor the complexity of authentic classrooms (Erickson, 2011). An important goal of teacher education is to equip teachers with the knowledge and skills to notice significant teaching and learning components and sift through complex classroom activities (Teuscher et al., 2017). According to Mason (2011), noticing is an intentional act, which "is a collection of practices designed to sensitize oneself so as to notice opportunities in the future in which to act freshly rather than automatically out of habit" (p. 35). To achieve this, teachers need to be reflective on their teaching and learning practices by describing and interpreting the salient features of the classes retrospectively

(Goodwin, 1994; Mason, 2011). Because noticing is an essential component of teacher expertise, prospective teachers need to learn noticing skills in their teacher education programs (Bastian et al., 2022; Blomberg et al., 2011; Copur-Gencturk & Rodrigues, 2021).

## Conceptual Framework

### Teacher Noticing

The concept of teacher noticing was first proposed by mathematics education researchers and has been making inroads in science education since the 2000s (Rodriguez, 2013). Science education researchers have found that teachers' noticing of specific aspects of science teaching and learning benefits their instruction in various ways. For example, researchers have found that teachers' noticing of students' reasoning about science concepts promotes responsive science teaching (Barnhart & van Es, 2020; Gotwals & Birmingham, 2016; Luna & Sherin, 2017), meaningful noticing of core science practices facilitates teachers' enactment of them in culturally and linguistically diverse classes (Bottoms et al., 2015), and purposeful noticing of students' science learning status fosters science teachers' reflective practices (Barth-Cohen et al., 2018).

Based on the work of Sherin and van Es (2009), teacher noticing is defined in this article as teachers' identification of classroom events and their subsequent knowledge-based reasoning about them. Although noticing research has focused on different noticing components, such as what teachers paid attention to and what they ignored (Star & Strickland, 2008), different ways teachers processed the identified classroom events (Sherin & van Es, 2009), and teachers' decisions on responding to the noticed events (Jacobs et al., 2010), researchers generally agree upon this conceptualization (Sherin, 2014; Sherin et al., 2011; Sherin & van Es, 2009).

### Supporting Teachers' Learning to Noticing Skills

Researchers have developed different tools to develop teachers' noticing skills. Among them, videos with associated scaffolding structures have been found to be effective (Castro Superfine et al., 2019; Dalvi & Wendell, 2017; Hawkins & Park Rogers, 2016; Kang & van Es, 2019). Videos allow teachers to watch classroom interactions multiple times as needed, and associated scaffolding structures facilitate teachers' knowledge-based reasoning of the noticed classroom events. Researchers have used different scaffolding structures. For example, Zummo et al. (2021) embedded guided questions in web-based annotation tools for teachers to reflect on their science instruction to promote teacher noticing. Similarly, Güler et al. (2020) employed the lesson analysis framework and provided specific questions for prospective teachers to respond to when they analyzed videos. Ulusoy and Çakıroğlu (2021) used a collection of structured questions during group discussions of video analysis, including examples such as the following questions: "What did you notice in the video," and "can you tell me more about why the student defined trapezoids in such a way?" (p. 261). To support prospective science teachers' noticing of student scientific thinking, Hawkins and Park Rogers (2016) facilitated community of practice meetings with guided questions to direct their attention to student thinking. Kalinec-Craig et al. (2021) found that specific sentence frames effectively promoted prospective teachers' noticing of students' mathematical strengths.

In addition to using video-based tools, the noticing literature has also emphasized the important role practical experiences play in teachers' development of noticing skills (Berliner, 2001). Kilic (2018) found that working closely with students in the classrooms promoted prospective teachers' noticing of student thinking skills. Similarly, when comparing the noticing of prospective teachers and veteran teachers in the domain of elementary science teaching, the results of Meschede et al. (2017) showed that veteran teachers were better at describing and interpreting relevant classroom situations than prospective teachers, which indicated the importance of practical teaching experiences in teachers' development of noticing skills. Given that most teacher education programs require prospective teachers to have at least one semester-long practicum or field experience before student teaching (Star & Strickland, 2008), providing prospective teachers with opportunities to practice noticing in a practical classroom environment becomes essential.

To summarize, research has shown the importance of noticing for science teachers, the effectiveness of video-based tools with scaffolding structures, and the benefits of engaging in practical classroom experiences in supporting teachers' noticing. The goal of this project is to equip prospective teachers with noticing skills in both video-based and authentic classroom settings in the context of science education, which has not been a focus of previous noticing studies. This article describes a model that employed an adapted critical incident framework (Tripp, 2012) as a scaffolding structure to facilitate prospective elementary teachers noticing in the context of science education, first in a video-based learning environment and then in the dynamic and complicated authentic classrooms. The prospective elementary teachers will be represented as preservice teachers (PSTs) in this article. The activities they engaged in during the project are related to their learning experiences in the science methods course they were taking and the associated practicum in which they were supposed to observe cooperative teachers' science instruction.

## Critical Incident Framework

The notion of critical incidents originated from the study of reflective practices. It has been used in teacher education as a guideline for reflection (Farrell, 2008; Howitt & Venville, 2009; Nott & Wellington, 1998; Richards & Farrell, 2005). Researchers conceptualized it slightly differently (Measor, 1985), but Tripp's (2012) definition, found in his book *Critical Incidents in Teaching* (originally published in 1993), is more applicable to teacher noticing. Below is how he described critical incidents:

> The vast majority of critical incidents, however, are not at all dramatic or obvious: they are mostly straightforward accounts of very commonplace events that occur in routine professional practice which are critical in the rather different sense that they are indicative of underlying trends, motives and structures. (Tripp, 2012, pp. 24–25)

He also elaborated on the creation of critical incidents:

> Critical incidents are not “things” which exist independently of an observer and are awaiting discovery . . . , but like all data, critical incidents are created . . . . Critical incidents are produced by the way we look at a situation . . . . To take something as a critical incident is a value judgement we make, and the basis of that judgement is the significance we attach to the meaning of the incident. (Tripp, 2012, p. 8)

According to Tripp (2012), critical incidents are not dramatic events or turning points during instruction. Some minor or everyday incidents can be created as critical incidents through teachers’ interpretation. It is the teacher’s analysis that makes events critical. Critical incident creation consists of two phases: description and explanation. In the first phase, teachers describe one specific event that drew their attention. The observed phenomenon is then interpreted by teachers in terms of its symbol, value, or role (Farrell, 2008; Measor, 1985; Tripp, 2012). These two processes are very similar to the two components of teacher noticing: attending to specific classroom events and the subsequent knowledge-based reasoning about them (Wang, 2019). When PSTs watch instructional videos and observe or assist with teaching in authentic classrooms, they create critical incidents first by recognizing the distinctiveness of events based on their current understanding of teaching and learning. PSTs then interpret events noticed in terms of their significance in a more general context. These experiences challenge teachers’ original understanding of teaching and learning, and new conceptions are constructed due to the opportunity to reevaluate and revise previous understandings through creating  the critical incident (Richards & Farrell, 2005).

Tripp’s critical incident (CI) framework consists of four components: (1) “describe [the] incident,” (2) “suggest [an] explanation and meaning within the immediate context,” (3) “find a more general meaning and classification/significance of [the] incident,” and (4) craft a position statement (Tripp, 2012, p. 26). To better align with the conceptualization of teacher noticing and PSTs’ learning in the practicum, I adopted the first three components, which include the identification of incidents and the interpretation of the noticed incidents in immediate and general contexts, and revised the fourth component, students’ takeaways from this noticing. For each component, I provided several prompts to facilitate PSTs’ documentation of their noticing. Table 1 shows the adapted CI framework that PSTs used to write their noticing journal entries.

**Table 1**
*Adapted CI Framework With Prompts*

| CI framework component | Prompt |
|---|---|
| Describe the incident | Please describe the moment/event/incident you have observed in detail. |
| Meaning-making in the immediate context | 1. Why did you pay attention to this event/incident?<br>2. What information can you tell from this event/moment? How would you explain this event? What meaning can you make from this observation? |
| Find a more general meaning | 1. What is the general meaning of the event?<br>2. What theories/principles can you connect with this event? |
| Your takeaways | What did you learn from this observation? |

## This Project

This project used an adapted CI framework as a scaffolding structure to promote PSTs' development of noticing skills in video-based and authentic classroom settings. In the following sections, I will introduce the model and describe PSTs' noticing in both settings. As described above, I adapted the CI framework and constructed prompts to guide PSTs in writing their noticing journal entries. PSTs learn to use these guidelines first in a video-based module in the first 2 weeks of the semester and then use the same prompts to guide their noticing in a 12-week practicum associated with a science methods course. I have implemented this adapted CI framework in the elementary science methods courses (with associated practicum) that I have been teaching for four semesters, and some minor revisions have been made through the semesters. The current version of the adapted CI framework and prompts is shown in Table 1.

The PSTs who enroll in the science methods course are seniors. They are required to complete two introductory science courses before taking this science methods course. The learning outcomes of this science methods course align with the *2020 NSTA/ASTE Standards for Science Teacher Preparation* (Morrell et al., 2020). The science methods course is 15 weeks in length, and PSTs start the practicum in Week 3 (3–6 hours each week). In Weeks 1 and 2, PSTs learn to notice with the adapted CI framework in a video-based module. From Week 3 through Week 14 in the practicum, PSTs write weekly entries in their noticing journals that are guided by the adapted CI framework. During the semester, the course instructor (the author) grades their noticing journal entries and provides feedback on their noticing and writing each week. PSTs are asked to incorporate their instructor's feedback in their subsequent journal writing. PSTs also sign up to lead a discussion of their noticing in the practicum lecture session (two PSTs each week). The steps describing how PSTs learn to notice in this course are listed below.

**Learning to Notice**

**Step 1: Students Learning to Use the Adapted CI Framework**

To provide students with the general meaning of the adapted CI framework, the third chapter of Tripp (2012) is first assigned as a reading task. In this chapter, Tripp defined a CI, provided several examples of CIs, and described the steps of creating a CI. In the lecture session of the class, the instructor summarizes the CI framework with a minilesson. Instead of discussing the definition of noticing, the lecture is centered on using CIs to promote learning from observing other teachers' instructional practices. Key information about CIs taught in the lecture includes the following points.

1. It is the meaning-making process that makes incidents critical, and CIs can be something small and trivial.
2. To make incidents critical, the specific event needs to be connected to general principles of teaching and learning.
3. Avoid long descriptions of class flow or general experience; focus on one specific event instead.

After the lecture, the instructor provides PSTs a science teaching video from the Teaching Channel that shows a second-grade teacher engaging students in scientific argumentation practice with the earth materials topic. After watching the video together, PSTs use the framework to document their own noticing. Then, PSTs discuss what they noticed and how they interpreted the identified events in small groups while the instructor circulates among the groups to facilitate their discussions. The objective of the small-group discussions is to emphasize that there is more than one valid way of interpreting the noticed events, and it is the interpretation process that matters.

**Step 2: Video-Based Training Module**

After in-class learning, PSTs are directed to complete an online video-based training module in the following week. Within this module, PSTs first watch two 8–10 minutes videos from the Teaching Channel, both of which are authentic science class videos at the elementary level. The science concepts that students were learning in the two videos are finding variations in living organisms and force and motion, respectively. Using the Google Assignment function in Canvas, PSTs submit the drafts of two noticing journal entries based on the two videos. The course instructor then provides individualized feedback to each PST with written comments. Comments include suggestions to make their writing align with the adapted CI framework and prompts to facilitate their reasoning about the events identified. After receiving feedback, PSTs revise their writing and submit the two revised journal entries again. In the revised journal entries, PSTs are instructed to highlight changes they made based on the feedback received. Grades of both the drafts and revised noticing journal entries count toward their final grades in the course.

After revising and submitting the journal entries, PSTs watch a new science instruction video on the topic of human impact on the environment and then write a noticing journal entry about the video. This final noticing journal entry serves as the data source for the instructor to assess PSTs' noticing using the adapted CI framework in the video-based setting.

To reduce the influence of PSTs' content knowledge on their noticing, the four videos were purposefully selected from different science disciplines, including biological science, earth science, and physical science.

### Step 3: Noticing in the Practicum

During the 12 weeks when PSTs attend practicum 3–6 hours per week as a part of the science methods course, they are asked to submit one noticing journal entry every week based on their observations in the practicum classrooms. As described above, the course instructor grades their journal entries each week with constructive feedback and returns their work before the due date of the next journal, which gives PSTs the opportunity to improve their writing in subsequent journal entries by incorporating the feedback. In addition to writing weekly entries in their noticing journals, PSTs also sign up for a date to lead a discussion about their noticing during the methods class lecture. During the 10–15-minute discussion, PSTs share what they noticed in the practicum classes and how they interpreted the observed events and then ask how other PSTs in the class interpret the same event.

## Learning Outcomes

### PSTs' Noticing in the Video-Based Module

PSTs noticing journal entries before and immediately after the video-based training module were coded with an inductive approach (see Table 2). Before the video-based training module, over two-thirds of PSTs only described the lesson flow or summarized some features of the lesson (e.g., students working together a lot) without identifying noteworthy situations. When explaining the meaning of what was observed, only about 23% of PSTs could assign some meaning to what they observed. This is not surprising because most PSTs' descriptions of what they noticed in the previous section were too broad for them to make meaning from. Similarly, moving beyond the immediate class context and making an explicit connection to some specific aspects of teaching and learning are challenging for PSTs. The last component of the framework requires PSTs to document what they learned from the video, but about one-third of PSTs continued by reiterating their observations. After the video-based training, most PSTs gained a better understanding of the adapted CI framework. The percentages of PSTs who identified specific noteworthy events, explained why the noticed events drew their attention, and explicitly connected their observation and meaning-making with general principles of teaching and learning all increased by more than 30%. The percentage of PSTs who made explicit connections to general principles of teaching and learning increased from 15% to 85%.

**Table 2**
*PSTs Noticing Before and After Video-Based Training Module (N = 59)*

| CI framework component | Code | Pre- | Post- |
|---|---|---|---|
| Describe the event | General description of the video content | 31% | 8% |
| | Summarized one feature of the lesson without referring to the video content | 23% | 8% |
| | Summarized one feature of the lesson and referred to the video content | 15% | 15% |
| | Focused on one specific event | 31% | 69% |
| Meaning of the event in the immediate context | Continued description of what observed | 23% | 0% |
| | Summary of the noticed lesson features | 54% | 23% |
| | Limited explanation of what observed | 8% | 23% |
| | Sufficient meaning-making | 15% | 54% |
| Find a general meaning of the event | Made no connection but continued description of the video content | 31% | 0% |
| | With some connection to the general principles of teaching and learning | 54% | 15% |
| | Meaningful explicit connection to a specific aspect of teaching and learning | 15% | 85% |
| Takeaways | Reiteration of the video content | 31% | 0% |
| | Broad discussion of what learned | 31% | 31% |
| | Documented specific strategies | 38% | 69% |

*Note*. The codes for each component are listed in order of increasing sophistication.

Two PSTs' noticing journal entries were presented as examples of PSTs' noticing before and after the video-based training module (see Table 3). These two journals were selected to represent how the before- and after-training journals can be different across the four components (Please note that all names are pseudonyms). Brianna's journal entry was written before she started the video-based training module, and Anita's was written immediately after the training module. As illustrated in Table 3, these two journal entries are different across all four CI components. As described above, prior to the training, PSTs tended to provide an overall description of the video content without identifying the specific event that deserved their attention. When examining the meaning of the observed events, PSTs experienced difficulties because of the lack of focus on what they had learned to pay attention to when using the adapted CI framework as guidelines. For example, after describing her observation of students debating, Brianna continued her description of students debating in the meaning-making block without sharing why she paid attention to this. The most salient difference occurred in the third component, connecting to general principles of teaching and learning, in which PSTs need to move beyond the immediate context and connect their observation to their knowledge of teaching and learning. It is an important stage in which PSTs further add to or reorganize their existing knowledge and prepare to act reasonably on class events in their future classrooms. In her journal entry for this block, Anita demonstrated how she connected her observation to the teacher's way of teaching scientific models and evidence-based argument. Finally, after the training module, PSTs can clearly summarize what they learned from their noticing after the video-based training module.

**Table 3**

*Two Examples of PSTs Noticing Journal Entries Before and Immediately After Video-Based Training*

| CI framework component | Before video-based training module (Brianna) | Immediately after video-based training module (Anita) |
|---|---|---|
| Describe the incident | General description of the video content. *The students were talking to each other about the environment and what they think is toxic.* | Focused on one specific event. *Building on individual models, students created three claims [as] to why the city flooded. The students discussed these claims and what model fits with each one.* |
| Meaning-making in the immediate context | Continued description of what observed. *I paid attention to this because each student was debating with their partner on why their thinking was better. Along with that, the teacher only gave them 1 min to talk to them.* | Sufficient meaning-making. *I liked how the teacher had students argue what model fit where. By having the students argue where each model belonged, they practice making [an] argument based off evidence and know how to effectively argue why they believe something is right or wrong.* |
| Find a more general meaning | With some connection to the general principles of teaching and learning. *I think this gives the students a chance to show what they have learned over the topic and along with what the teacher has taught them to use specific words (in my opinion).* | Meaningful explicit connection to a specific aspect of teaching and learning. *This is a great example of how you can teach scientific models and evidence-based arguments by allowing students to think on their own and collaborate with one another.* |
| Your takeaways | Reiteration of video content. *I learned that the teacher was going to every group and listening to them and seeing what they were saying.* | Broad discussion of what learned. *I learned that students can effectively work together when it comes to science. Students can also engage in evaluating issues using scientific evidence.* |

*Note*. Quotations from prospective teachers' noticing journal entries are shown in italics below the code describing that response.

### PSTs' Noticing in the Practicum Setting

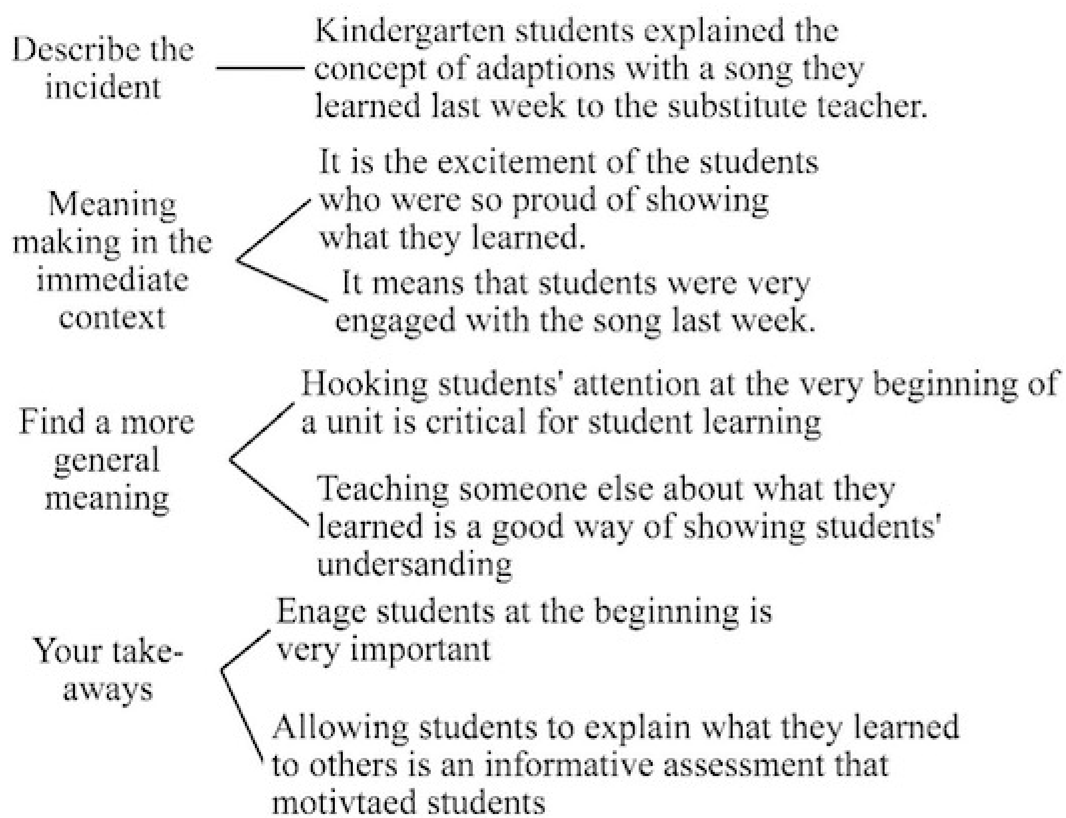
To capture PSTs noticing in the practicum after the video-based training module, I inductively coded PSTs noticing development patterns and calculated the percentages of PSTs under each pattern (see Table 4). Overall, 58% of the PSTs maintained a stable high-level noticing throughout the rest of the semester. Their learning in the video-based training module was maintained, and the practicum experiences seemed to benefit their noticing development. Twenty-five percent of the PSTs exhibited high-level noticing when they were exposed to science instruction in the field that aligns with the methods course instruction. Seventeen percent of the PSTs could only interpret specific aspects of teaching and learning well. For example, Carly consistently connected to different classroom management principles when she focused her attention on students' behaviors; however, when no noteworthy event related to student behavior was observed, she experienced difficulties in reasoning about other events.

**Table 4**
*PSTs Noticing Development Patterns in the Practicum (N = 59)*

| Patterns | Number of PSTs |
|---|---|
| Stable high-level noticing | 34 (58%) |
| High-level noticing when exposed to science instruction | 15 (25%) |
| High-level noticing with specific observations | 10 (17%) |

Figure 1 summarizes a high-level noticing journal entry from one PST. As illustrated in the summary, PSTs can focus on specific events, clearly share why they pay attention to them, connect the observation to general principles of teaching and learning (in this case, student engagement and informative assessment strategy), and summarize what they learn from this noticing. This example shows PSTs' facility in using the adapted CI framework to document their noticing in an authentic classroom setting.

**Figure 1**
*Summary of One Noticing Journal Entry in the Practicum*




## PSTs' Feedback on Developing Noticing Skills

Based on PSTs' feedback, the experiences of writing noticing journal entries with the adapted CI framework, along with opportunities of sharing and discussing their noticing during each lecture session, promoted their learning in the practicum. Below are two examples of PSTs' evaluation of noticing journal entries from their midterm evaluation of the course. As described above, the concept of noticing was not explicitly introduced in class, so PSTs referred to this as "practicum discussions" and "observation journals." One of the PSTs commented, "The observation journals help me reflect on what type of teacher I want to become and have helped me pick up some tricks." Another PST discussed how these experiences benefited her learning

> I also think it is helpful to have practicum discussions. It helps me to learn from my peers about things that are happening in their practicums. Reflecting on my own practicum weekly has also been beneficial in helping me to learn in this course.

**Further Considerations**

Below, I will share some thoughts and considerations that I learned from implementing the model to support PSTs' development of noticing skills. Specifically, student learning difficulties and factors influencing the use of the model will be discussed.

The most challenging component of the adapted CI framework for PSTs is the third one, making connections between their identified event or moment and the general principles of teaching and learning. For this component, PSTs are asked to move beyond the immediate context and make abstract meaning from the event noticed. PSTs need additional guidelines on what they can make connections with. To facilitate PSTs making connections, in addition to providing weekly feedback on their journals, I gave them six broad categories on which they can decide to focus each week during the semester: (1) classroom rules, procedures, and routines; (2) instructional strategies; (3) student learning or understanding; (4) assessment; (5) teacher orientation; and (6) curriculum. PSTs were encouraged to focus their noticing journal entries on as many categories as possible during the semester. This addition helped PSTs to frame their noticing around specific areas.

The limited amount of science instruction that some PSTs observed in the practicum was another factor. Not seeing much science instruction made it very difficult for PSTs to connect their practicum observation with science teaching and learning principles discussed in the science methods course. Since the start of the pandemic, recruiting host teachers who teach science during the times when PSTs are visiting schools (Wednesday mornings) has not been easy because school buildings cannot host as many prospective teachers as before. As a result, many PSTs were exposed to a very limited amount of science instruction. Several PSTs only observed one or two science lessons during the semester. When PSTs do not experience much science teaching, either because science is not taught in their practicum or is taught on other days, they cannot understand the lesson objective or relate their observation to pedagogical knowledge discussed in the science methods course. To address this issue, our program is planning to schedule the science methods course and math methods course in one semester and purposefully recruit cooperative teachers from local STEM-certified schools. We hope these strategies of having one “STEM” semester and partnering with STEM-certified schools will expose our prospective teachers to more science instruction in the practicum.

Another consideration of using this model to promote PSTs’ noticing is the importance of providing continuous feedback on their noticing journal. After learning to notice within a video-based environment, PSTs need continuous support in writing noticing journal entries during the practicum when they observe authentic classes. The noticing knowledge and skills learned in the video-based environment are not naturally transferred to the authentic classroom setting without support. I had one semester when the majority of the PSTs gained a good understanding of using the CI framework during video-based learning, and I stopped providing feedback on their practicum noticing journals. It turned out that PSTs’ noticing journal entries deteriorated, and they did not see the benefit of using them. I think one reason is that the videos used were short and focused on some specific aspect of science teaching strategy, whereas the authentic class is more dynamic and complex. Therefore, providing feedback on each journal entry and asking PSTs to incorporate that feedback in the following journal writing is necessary. For example, in the feedback I gave on noticing journal entries during the first 2–3 weeks, I frequently advised PSTs to focus on events related to aspects of teaching and learning and disregard those that were not, such as students seeking permission to go to the bathroom.

**Conclusion**

As a core component of teaching expertise, teachers’ effective noticing skills benefited their instruction (Bottoms et al., 2015; Gotwals & Birmingham, 2016). Based on the teacher noticing research and the adapted CI framework, this article describes a model of supporting PSTs’ noticing in video-based and authentic classroom settings. As described before, I have been implementing this model for four successive semesters and have been making minor revisions each semester. Based on these experiences, I found the model effective in supporting PSTs’ noticing skills in both settings. With appropriate support, such as using the adapted CI framework as a guideline and providing continuous feedback throughout the semester, PSTs can develop noticing skills within their teacher education program. It is also worth mentioning that the practicum classroom environment is critical for their development of noticing skills. When the cooperative teachers do not teach science much, PSTs can only focus on their classroom management skills, which is not beneficial for them in developing their science-specific noticing skills. I encourage fellow science teacher educators to adopt this model, revise it as needed, and share their results when PSTs are exposed to science instruction in the practicum.

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