

# Framing Reflections on Instruction: A Precursor to Noticing

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**Abstract:** Noticing is the ability of teachers to attend and interpret student thinking to guide instructional design (van Es & Sherin, 2002). The skills involved in noticing can be challenging to develop in teacher education programs because of the cognitive load involved in attending to the context of the real classroom environment. Teacher education programs can thereby study a precursor to noticing, such as framing. Framing instruction involves developing a range of “seeing” events in the classroom. Thus, preservice teachers must frame their teaching experience in ways that privilege student thinking. In our investigation, we characterized the frames preservice teachers employed in their reflection paper. We found that preservice teachers who used frames that were more attentive to student ideas were more capable at analyzing student understanding in written student artifacts.

## Introduction

Over the past three decades, standards documents have emphasized the importance in engaging students with the epistemology and practices of scientific inquiry (National Research Council [NRC], 1996, 2007, 2011). Since teachers mediate students’ science learning, teachers must develop the knowledge and practices to implement inquiry teaching (Abd-El-Khalick & Lederman, 2000). An essential component in the implementation of inquiry-based teaching is the ability to attend to and interpret student ideas and to use such interpretations to guide instructional design (van Zee & Minstrell, 1997). The idea of attending to student thinking is not new- it has been a core aspect of pedagogical content knowledge (PCK) models for decades (e.g., Grossman, 1990; Magnusson, Krajcik, & Borko, 1999). More recently, Windschitl et al. (2012) advocated for instructional tools that support ambitious teaching, including practices that help teachers attend to student ideas. However, despite the need and benefits of attending to student thinking, this practice poses a major obstacle for experienced teachers and is even more difficult for preservice teachers (PTs) (Chamberlin, 2005). In particular, PTs struggle to make sense of student ideas and to develop these naïve ideas towards more normative understandings (Friedrichsen et al., 2009). Given these obstacles, we investigated whether and how PTs attended to student understanding in a science classroom.

## Theoretical Framework

In every field, experts have the ability to notice and interpret events in their domain- they have “professional vision” (Goodwin, 1994). van Es and Sherin (2002) developed the framework of “noticing” to capture the notion of professional vision in teaching. The ability to notice consists of three sub-skills: (a) identifying what is important, (b) making connections between the specifics of classroom interactions, and (c) using what one knows about the context to reason about the classroom situation. Sherin et al. (2008) argued that the development of these skills poses challenges because classroom interactions, the fodder for noticing, are often fleeting and several occur simultaneously. It is even more challenging to help PTs develop these skills due to the cognitive load involved in attending to the messy contexts of real classroom interactions. Obtaining videos of PT instruction can also pose logistical challenges in some districts. To circumvent these issues, teacher educators can focus on the development of precursors to noticing. Framing instruction as being about student thinking may be a precursor to noticing. Hammer et al. (2005) termed frames as lenses to instruction and argued that framing involves developing a range of “seeing” events in the classroom. Therefore, a frame refers to expectations an individual has about a situation that affects what they notice and how they act. In order to develop the skills necessary for noticing, PTs must first frame their teaching experience in ways that privilege student thinking such that they observe these ideas and are subsequently able to interpret and respond to them. Levin, Hammer, and Coffey (2009) found that PTs have the ability to attend to student thinking, but what they notice in class depends in part on how they framed the lesson.

Most research that studied framing used video; however, in our investigation, we wanted to see if we could measure framing through written reflection papers. Researchers (i.e., Cavanaugh & Prescott, 2010; Hatton & Smith, 1995) have advocated for the use of reflection in teacher education programs as a vehicle to shift PTs attention away from themselves and towards attending to student thinking. Further, reflection fosters personal and professional growth, which has shown to improve teachers’ knowledge and awareness of their classroom practices, including developing an awareness of student ideas (Baird et al., 1991). Engaging PTs in reflective practices could enhance the precursors of noticing, specifically framing, because how the reflection is framed places an emphasis on learning through questioning and investigation since it occurs after the lesson was taught,

thereby, eliminating all time constraints and other classroom pressures. By characterizing the frames that are expressed, teacher educators will be able to examine the various ways PTs attend to student ideas as well as study the development of framing, which could be a precursor to noticing. Therefore, our research questions for this study are:

- To what extent do PTs' framing of their lesson reflections account for student thinking?
- How do the frames expressed by PTs change over the course of a two-year teacher education program?

## Methods

### Study Context

This study was conducted in the context of a two-year Ed.M. certification program for secondary biology teachers. There were 16 PTs enrolled in the program. Four of the PTs were males and twelve were females. Fifteen of the PTs were Caucasian while one was of Asian descent. All of the PTs' undergraduate degrees were in the biological sciences with nine having biology degrees, three having animal science degrees, three having environmental science degrees, and one having a molecular biology degree.

The two year Ed.M. program included four life science methods courses that were taken in sequence (including a seminar that accompanied student teaching). The methods courses were geared to the development of knowledge and practices of model-based inquiry instruction. Each methods course had a slightly different focus. The first course, *Methods I*, focused on developing PTs knowledge of the nature of scientific inquiry. *Methods II* was a design course in which the PTs worked in groups to design an extended inquiry-based unit as well as implemented a short inquiry-based lesson. *Methods III*, which accompanied the student teaching internship, focused on the implementation of inquiry-based instruction as well as reflecting on their instructional methods. The majority of the PTs (15 out of the 16) completed their student teaching practicum in suburban high schools in the northeast while one of the PTs completed the requirement at an inner city high school in the northeast. Finally, the last course, *Methods IV*, engaged teachers in action research using data they had collected during their student teaching internship. The data that we used in this study was taken from *Methods II* and *Methods III*.

### Data Collection

In this study, we used four assignments from *Methods II* and *Methods III*: (a) teaching experiment reflection paper from *Methods II*, (b) lesson set I and II reflection papers from *Methods III* and (c) reflective journals from *Methods II* and *Methods III*.

### Teaching Experiment Reflection

The PTs were required to teach a lesson during the second methods course as part of their fieldwork and were asked to write a reflection paper about their experience. The reflection paper was divided into three sections. In the first section, the PTs were asked to provide a description of what went well and what did not go well in the lesson. In the second section of the reflection paper, the PTs were asked to select written student artifacts from the lesson and analyze the artifacts for student understanding in terms of scientific practices and content. In the third section of the paper, the PTs were asked to reflect on the revisions they would make to this lesson. In this study we analyzed the first two sections of the reflection paper.

### Lesson Set Reflection I and II

During the third methods course, the PTs were asked to develop and implement two inquiry-based lesson sets during their student teaching practicum. Lesson set I was completed early in the semester (weeks 4-7) while lesson set II was completed towards the end (weeks 10-14). The lessons had to focus on model-based inquiry instruction. After implementing the lessons, the PTs were asked to provide a description of the lesson as well as to select written student artifacts from the lesson to analyze for student understanding in regard to scientific practices and content. We analyzed their descriptions on their lessons as well as their analysis of student artifacts.

### Reflective Journals

The PTs were required to maintain a reflective journal throughout the two courses and to provide entries of about 250-300 words weekly. There were two types of journal entries: (a) answers to prompted questions that we asked several times during the course (i.e. what are the features of a scientific argument) and (b) personal and 'free-style' reflections on that week's class.

## Data Analysis

We initially blinded all data sources in terms of PT and reflection paper. Using a constant comparative method (Glaser, 1965), we read through the sections of the reflection papers in which the PTs were asked to describe the previously implemented lesson. We noted any emergent frames (lenses) the PTs expressed. A frame was defined as the interpretative viewpoints PTs expressed while reflecting on lessons. For example, a focus on student participation or students staying on task would be categorized as an *engagement* frame. We identified six distinct frames, which we describe in the results section.

We then un-blinded the data to look for any trajectories of change in frames the PTs employed over the course of the teacher education program. We were interested in examining whether there were any clear patterns or shifts in the frames the PTs expressed. We noticed that three of the PTs did not hand in one of their reflection papers and another two of the PTs did not follow a clear pattern of change- they regressed and then progressed. Therefore, we selected the remaining eleven PTs for a more in depth analysis of shifts, seven of these PTs continually progressed towards framing instruction in ways that were more attentive to student thinking while the other four PTs selected did not progress (i.e., they either regressed continuously or used the same frame) in the frames they employed. For those selected PTs, we then analyzed the section of their reflection papers in which they were asked to analyze student understanding in written student artifacts that they had collected. We were interested in exploring whether those who employed frames that were more attentive to student thinking were more capable at identifying what students understood in the lesson. We read through that section of the reflection paper and using a constant comparative method (Glaser, 1965) noted any observed differences.

For the final part of our analysis, we wanted to examine whether the content of the different frames changed throughout the course of the teacher education program. We constructed tables for each frame according to the reflection papers (i.e., three tables for each frame) and highlighted the content that the PTs wrote about. For example, many PTs wrote about student participation when employing an *engagement* frame for all three reflection papers. The tables that we constructed consisted of the aspects of participation the PTs wrote about such as working collaboratively, quietness of students, and attentiveness of students in the teaching experiment paper and how students asking questions turned the lesson into a heated debate in lesson set II reflection papers. We reported the observed differences in the results section.

We triangulated the data by reading through journal entries that were written at the time of the implemented lessons (i.e., same time point as the reflection papers) to determine whether PTs expressed similar frames in the journals as were expressed in the reflection papers. We established inter-coder reliability by having two independent coders code the reflection papers (reliability ranged between 95-97%); any disagreements were resolved and codes were adjusted to reflect the consensus.

## Results and Discussion

### To What Extent to PTs' Framing of Their Lessons Account for Student Thinking

We identified six emergent frames described in table 1. We found that the PTs accounted for student understanding and student ideas to varying degrees. Table 1 presents the frames from the least to most attentive to student understanding. For example, PTs who employed the *engagement* frame focused on the students' interest and participation in a lesson with not much emphasis on student thinking. On the other hand, frames such as *scientific practices- students* and *building ideas* accounted for student understanding in either pedagogical practices or content. These results are encouraging because it revealed that PTs are able to attend to student thinking and that attention to thinking is a salient aspect of teaching for them. However, some PTs tended to express frames that did not account for student ideas, such as *activity sequence* frame. Davis (2006) argued that when PTs attend to learners their reflection centers on students' interest and motivation rather than learning content, which we also observed here. In our triangulation, we identified the same type of frames in both data sets (i.e., reflection papers versus reflective journals). In general, we found that PTs tended to express one frame or at most two. It also seemed that the PTs tended to employ the same frame regardless of the assignment (i.e., reflection paper versus journal prompts that were written around the same time as the reflection papers).

Table 1: Descriptions of emergent frames observed

Frame	Description of the Frame	Example from Reflection Paper
<i>Activity Sequence</i>	Characterized by a focus on providing a narrative or description of the lesson with minimal	"The students worked with the person they were sitting next to and talked about what they think happened in the story. After a little bit of time, volunteers read aloud their answers." (Nina, Lesson Set II)

Frame	Description of the Frame	Example from Reflection Paper
<i>Scientific Practices- Teacher</i>	Characterized by a focus on the teachers actions as they related to scientific practices, such as modeling, argumentation, etc.	"I handed each student modeling worksheets. Being as modeling is not something my students are familiar with, I felt it was necessary to help get them started so I wrote down the first two steps in the sequence of a fever with arrows on the board." (Jake, Lesson Set I)
<i>Engagement</i>	Characterized by a focus on student interest, participation, and staying on task.	"The story part went well, both periods were quiet, listening, and for the most part seemed interested." (Molly, Teaching Experiment Paper)
<i>Accuracy</i>	Characterized by a focus on obtaining the right answer. Teacher interprets student understanding in a binary way, either as correct or incorrect.	"The students demonstrated a basic form of knowledge of the content but did not go into much detail at all. A few students came up with the idea that antibodies were in the body." (Bani, Lesson Set I)
<i>Scientific Practices- Students</i>	Characterized by a focus on students' actions while implementing scientific inquiry practices such as modeling and evidence-based argumentation.	"None of the students used the data for generating evidence for claims, like viruses have various proteins...they [the students] failed to connect (link) data to evidence when making individual models." (Patrick, Lesson Set I)
<i>Building Ideas</i>	Characterized by a focus on taking students' knowledge and building upon it. Teacher interprets student's current level of understanding and describes possible connections to other content or suggests material to facilitate desired connections.	"By evaluating the worksheets I was able to provide material to help them [the students] more fully understand the implications of their solutions on the system as a whole by providing examples of previous attempts and solutions or additional data about the factors they involved." (Rachel, Teaching Experiment Paper)

### How Do the Frames Expressed by PTs Change Over the Course of a Teacher Education Program

PTs tended to express different frames throughout the teacher education program (Table 2). It seemed that initially the PTs tended to focus on the interest and participation of the students and there was a small shift towards focusing on student thinking. In general, we found that PTs tended to express one frame or at most two. It also seemed that the PTs tended to employ the same frame regardless of the assignment (i.e., reflection paper versus journal prompts that were written around the same time as the reflection papers).

Table 2: Frames observed according to reflection papers

Frame	Teaching Experiment Paper	Lesson Set I	Lesson Set II
<i>Activity Sequence</i>	0	3	3
<i>Scientific Practices- Teacher</i>	1	3	0
<i>Engagement</i>	13	3	3
<i>Accuracy</i>	2	3	0
<i>Scientific Practices- Students</i>	1	3	6
<i>Building Ideas</i>	1	1	3

We then looked at how individual PTs shifted throughout the course of the teacher education program (Table 3). We noticed that many of the PTs used different frames than they had employed in their first reflection paper. For example, during *Methods II* Sean wrote, “The lesson flowed smoothly. The students were engaged and the transitions between activities really caught their attention.” Sean expressed an *engagement* frame because his focus was on the alertness and time on task of his students. Conversely during *Methods III*, Sean’s focus completely shifted. He stated “The best part of the lesson was when the students were working with their models. They were able to construct logical representations of the material we had just covered.” Here, Sean expressed a *scientific practices- student* frame because his focus was now on how the students constructed models rather than their interest in the lesson. We observed this change in both the reflection papers and the reflective journal entries.

Similarly, Jackie in her teaching experiment paper wrote “I found the students were very willing to participate in a respectful manner, raising their hands before speaking or calling out when there were no other hands raised.” Like Sean, Jackie expressed an *engagement* frame because her focus was on the students’ participation in the lesson. However, Jackie’s lesson set II reflection paper had a completely different focus. In this reflection paper, Jackie was concerned with what the students were saying and how that related to their overall learning process. For example, she stated:

“I made a concept map on the board but the map was really made entirely by the students as I would not write anything on the board until they discussed the ideas and concluded it was important to include. The students were able to take their initial ideas and elaborate and build upon them until they fully expressed their understanding.”

In this example, Jackie expressed a *building ideas* frame because her focus in the lesson was now about the students elaborating and connecting their ideas. Further, we observed this shift in both the reflection paper and reflective journal prompts. It seemed that as the PTs gained more experience working with students in a classroom, they began to shift their focus from students being on task to becoming more aware of what students were actually saying and how their ideas related to core concepts. Thus, more classroom experience supported a shift from a focus on themselves to a focus on students’ thinking (Berliner et al., 1988).

Table 3: Frames expressed by PTs throughout the teacher education program

	Teaching Experiment Paper	Lesson Set I	Lesson Set II
Christine	Engagement	Activity Sequence	Engagement
Patrick	MISSING DATA	Scientific Practices-Students	Engagement
Jackie	Engagement	Scientific Practices-Teacher	Building Ideas
Nina	Engagement	Engagement	Activity Sequence
Jack	Engagement	Accuracy	Building Ideas
Catherine	Engagement	Engagement	Activity Sequence
Sean	Engagement	Accuracy	Scientific Practices-Students
Nora	Engagement	Scientific Practices-Teacher	Activity Sequence
Molly	Engagement	Scientific Practices-Students	Scientific Practices-Students
Nadia	Engagement/Scientific Practices- Students	Activity Sequence	Building Ideas
Ava	Engagement/Scientific Practices- Teacher	Scientific Practices-Students	Scientific Practices-Students
Bani	Engagement/Accuracy	Accuracy	Scientific Practices-Students
Jake	Engagement/Accuracy	Scientific Practices-	Scientific Practices-

		Teacher	Students
Clare	Engagement	Engagement	Scientific Practices-Students
Rachel	Building Ideas	Building Ideas	MISSING DATA
Anna	MISSING DATA	Activity Sequence	Engagement

\*We assigned a “missing data” code if PTs did not submit an assignment

We next wanted to explore whether the content of the different frames changed throughout the course of the teacher education program. We found that PTs began to be more elaborate and detailed in their descriptions of students’ ideas in certain frames, specifically *scientific practices- students* and *building ideas*. Initially many of the PTs, who employed these frames, commented that the students had a difficult time explaining their models. They made statements like “the students did not explain or justify their models.” However, in later reflections the PTs became more nuanced and explicit about *the ways in which* the students had difficulty using data stating that, “the students’ content knowledge ability impacts how they understand the data and how they support their models” and “the students interpreted the data from the experiments and activities we performed in class and were able to incorporate this data to provide evidence based explanations.” It seemed that the PTs began to see how different aspects of their students’ learning process impacted their modeling skills. Overall, this shift was observed by all the PTs who employed *scientific practices- students* and *building ideas* frames in *Methods III*.

In addition, we found that there was a shift in the frequency with which PTs used students’ responses in the form of quotes or comments from lesson activities when comparing the teaching experiment paper and the lesson sets. Initially, none of the PTs cited student responses in their reflection papers written for *Methods II*, while the majority of PTs used statements from students in their Lesson Set II reflection papers (Table 4). It seemed that as the PTs gained more experience in the classroom through their student teaching practicum, they became more aware of what students were saying and began to use the students’ responses as evidence for justifying their reflections.

Table 4: Number of PTs who cited student responses in their reflection papers

	Teaching Experiment Paper	Lesson Set I	Lesson Set II
Number of PTs Who Used Student Responses	0	13	14

Although we did not observe a significant trajectory of change throughout the teacher education program, we wanted to explore what was different about the reflections written by the PTs who progressed towards framing instruction in ways that were more attentive to student thinking such as Sean, Ava, and Molly (to name a few). We found that in the earlier reflection papers, there were “seeds” of frames that were more attentive to student ideas. For example, in the teaching experiment paper, Sean’s main focus was how the students participated in the lesson (*engagement* frame) but there were several statements about “bringing out student ideas.” Additionally, Ava’s main concern in the teaching experiment paper was about the students being on task during the activity (*engagement* frame) but Ava made several comments about “connecting ideas amongst topics as an effective instructional strategy”. Overall, it seemed that in order to progress toward frames that were more attentive to student ideas there has to be an initial “seed” that becomes more prominent with experience.

For the final part of our analysis, we analyzed the section of the reflection papers in which the PTs were asked to analyze student understanding in the lesson. We wanted to explore if the PTs who progressed towards framing instruction in ways that were more attentive to student thinking such as Sean, Ava, and Molly (to name a few) were more capable of identifying what students understood or did not understand in their analysis as compared to PTs who did not progress in how they framed their lesson reflections such as Catherine, Nina, Nora, and Christine. In general, we found that PTs who progressed in how they framed instruction were more capable at identifying what students did not understand, commenting on students’ prior knowledge or suggesting what topics should be stressed to learn the material. We also observed that the PTs were more interpretative of student understanding as the frames they employed were more focused on student thinking.

For example, in his teaching experiment paper, Sean, who progressed in the frames he employed, commented on what the students were not grasping in the lesson stating, “Every student verbally told me that onion cells do not have chloroplasts and elodea cells do, but many of their diagrams of onion cells included chloroplasts so I don’t know where the disconnect is.” Conversely, Catherine, who did not progress, commented

in the teaching experiment paper, “I think the students have a general understanding of what makes up a vertebrate” with no further elaboration. In both these instances, Sean and Catherine both employed an *engagement* frame when reflecting on their lessons but there is a significant difference in how they interpreted student thinking with Sean being much more specific about what the students were not understanding and provided evidence to support his claim.

In the final reflection paper, lesson set II, Sean, who employed a *scientific practices- students* frame, stated in his analysis of student understanding:

“The models [that students drew] imply that the dots and lines among the required species are additional species (ancestors to humans), but the students do not label as such and do not explain them in their description. This shows that these students are missing a concept and are “filling in the blanks” of their understanding with these “dots and lines”.

Here, Sean interpreted student understanding based on the lack of details in the students’ models, which he believed indicated a missing connection amongst scientific ideas, in this case the evolution of species from common ancestors. In Catherine’s final reflection paper (she employed an *activity sequence* frame), she stated, “Initially a majority of the students thought that bones are alive. They justified their opinion with correct ideas about the characteristics of living things.” Catherine further elaborated her analysis by citing a student response from the lesson stating: “In Mala’s model she wrote, “I think they [bones] are (alive) because when the body grows the bones grow too. All living things that have bones grow.” However, although Catherine’s analysis of student understanding was more evidence based (i.e., provided a response from a student) than in her initial reflection paper, she was still not as attentive to student understanding in regards to the students’ overall learning process, whereas, Sean was much more analytical in his reflection by providing suggestions for what missing details in students’ models suggested about their overall learning. In general, it seemed that the PTs who progressed in using frames that were more attentive to student thinking were more analytical in their examination of student understanding.

## Conclusions and Implications

We observed a slight shift towards employing frames that were more attentive to student thinking as the teacher education program progressed. This finding suggested that teacher education programs should provide PTs with instructional tools when reflecting on lessons. Providing these tools will encourage PTs to employ frames that attend to student thinking and thus PTs will be more capable of analyzing student understanding in written student artifacts, an essential skill they will need in their future teaching career. Additionally, our findings suggested a methodological implication. In the past the notion of framing has been studied using videotape analyses but our results indicated that framing can be examined through analyses of written work, such as reflective practices.

These findings suggest that teacher education programs should provide PTs with instructional tools when reflecting on lessons. Providing these tools will encourage PTs to employ frames that attend to student thinking and thus PTs will be more capable of analyzing student understanding in written student artifacts, an essential skill they will need in their future teaching career.

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