Implementing a Lesson Plan Vs. Attending to Student Inquiry: The Struggle of a Student-Teacher During Teaching Science

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Abstract: Despite calls for student-centered, inquiry-based instruction in science, science teacher preparation remains mostly teacher-centered, with the underlying assumption that novice teachers need to form a teaching identity before attending to their students' inquiry. In this paper, we use the idea of framing to analyze a 42-minute science lesson of a senior kindergarten student-teacher. Findings suggest that the student-teacher struggled for balance between teaching science as implementing a lesson plan, and as attending to her students' inquiry. We use this evidence to suggest that novice teachers can attend to students' inquiry as early as in their student-teaching experience, which suggests additional pressure on the need for preparation in teaching science. Thus, the role of science methods courses should be to help students understand the different interpretations of teaching within the different frames and provide them with strategies for entering more productive frames during teaching.

Introduction

Despite decades of calls for promoting students' inquiry in science in grades K-12 (NRC, 2000; 2007), this agenda has been slow to become established in instructional practice (Minstrell & van Zee, 2000; Osborne et al., 2004), possibly for a number of reasons. First, despite a wide consensus regarding the importance of inquiry in science learning, the education community has yet to agree on precisely *what* is important in scientific inquiry (Anderson et al, 2000). For many, inquiry is a method for learning science "content," while for others, inquiry is a part of science and an objective in itself. Secondly, there is no agreement regarding what "productive" inquiry should include, especially in the early grades. Answers have varied from general appeals for "messing about" to more specific targets for developing "concrete" abilities such as controlling variables (e.g., Metz, 1995).

In contrast to the tangible and more straightforward objectives of traditional content, when considering these ambiguities, the difficulty of sustaining instructional attention to student inquiry is understandable (Hammer, 1995). Regardless of the particular account of children's inquiry, there always exists the challenge of diagnosing student progress in any classroom situation (e.g., Goodwin, 1994). Developing such diagnostic abilities for identifying and responding to students' scientific inquiry depends largely on teachers' professional development (both pre- and in-service) in teaching science. While a number of studies have looked into how teachers in primary and secondary education teach science (e.g., Kuiper, 1995), little is known about how kindergarten teachers implement the science aspects of the curriculum (e.g., Kallery & Psillos, 2002). To make progress in promoting student inquiry especially in early grades, science education needs to develop a better understanding of how teachers perceive and respond to student inquiry in classroom settings and what struggles they encounter to implement inquiry-based teaching.

The purpose of this case study is to contribute towards this understanding and development, by proposing and applying a specific methodological approach which helps to describe how a senior student-teacher conceived her role in the class and how her behavior reflected a struggle to balance between teaching science as implementing a lesson plan she had developed and received approval for by her tutor, in contrast to attending to her students' scientific inquiry. We use the idea of framing (Goffman, 1974; Tannen, 1993; Schank, 1990) to analyze a 42-minute science lesson of this student-teacher. In doing so, we seek to show how using the idea of "framing" in the context of analyzing student-teaching may prove useful in understanding the process of novice teachers' professional development and in identifying areas in which teacher education may support this. We also argue that it is not unrealistic to expect novice teachers to be able to attend to and respond to students' inquiry during real-time teaching.

Theoretical framework

Emphasis of science education in inquiry-based, student-centered approach

Following recent changes and reforms in curricula, science has become established as part of the early primary curriculum (The Curriculum Guidance for the Foundation Stage QCA/DfEE, 2000). The National Research Council (2007) strongly recommended the development of an approach for teaching science in kindergarten through eighth grade, in which science is viewed as providing opportunities for both learning and development, or to lay down the foundations in preparation for future learning in science (Kamii & DeVrie, 1993). In this context, considerable attention is given to children's own explorations and inquiry (QCA/DfEE 2000), with a number of researchers emphasizing the importance of engaging young children in hands-on science experiences which support the development of an early interest and knowledge base in meaningful scientific themes, and which provide children with an introduction to and support for developing science inquiry skills (e.g., Chen & McNamee, 2007; Kamii & DeVries, 1993).

Current emphasis in science education highlights among other things the support of student inquiry (NRC, 2000; 2007), promoting it as the central strategy for teaching science. The National Science Education Standards (NRC, 1996) has provided a definition modeled after the work of scientists where scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. Numerous other definitions can be found in the literature, which vary in their emphasis (e.g., Barman, 2002; Flick, 2002; Crawford, 2006). Taking all these into account, for the purpose of this paper, we take student inquiry to mean the pursuit of causal, coherent explanations of natural phenomena (Hammer, 2004) which may take many forms, both experimental and theoretical. Regardless of the form, the instructional agenda is to help students learn to engage in that pursuit for themselves. In this view, science inquiry supports the development of problem solving, communication and thinking abilities as students pose questions about the natural world and seek the evidence to answer them (NRC, 2000).

Preparing teachers for inquiry-based teaching in science: approaches and challenges

Despite NRC's (2000; 2007) current emphasis on "student-centered" instruction in science education, only a few programs have been designed to support pre-service teachers in developing their knowledge about scientific content and inquiry (e.g., McDevitt et al., 1995). On the whole, teacher preparation for teaching science remains largely teacher-centered. Science methods courses focus on the things teachers (should) do, on instructional methods (Tobin & Fraser, 1990), management strategies (Feiman-Nemser & Parker 1992), questioning skills (Fleer & Hardy, 2001), evaluation procedures (Jarvis et al., 2001), and planning processes (Lenton & Turner, 1999), putting much of the emphasis of teacher preparation programs on helping teachers form a teaching identity (e.g., Freese, 2006).

The teacher-centered approach of preparing pre-service teachers to teach science has been strongly influenced by stage-based accounts of teacher development (Kagan, 1992). Teacher developmental stages refer to the stages through which teachers progressively gain professional knowledge, abilities and beliefs (Nimmo, 1994). This approach proposes that during initial stages of their development, novice teachers need to clarify and construct their self-image as a teacher by developing routines related to classroom management and instruction. Beginning teachers' concerns tend to focus primarily on self and self-image as a teacher, rather than on students' learning. Consequently, the level of effort and skill required by beginning teachers to teach science using inquiry-based approaches may not be achievable for many. Therefore the tendency in these instances is to revert to authoritarian, teacher-directed approaches (Harlen, 1996). In this context, activities or units that work are seen to be effective partly because they engage students, in the sense that they keep students interested. Although this approach results in teachers focusing on their own behavior before they can attend to student learning, it is seen as a crucial step early in their professional development (Kagan, 1992). Once they have "resolved" an image of themselves, novice teachers can then shift their attention to attending to and responding to their students' inquiry. Thus, the challenge to integrate aspects of teaching science as inquiry, into their planning and instruction maybe frustrating for novice teachers.

Conversely, Crawford (1999) suggests that it is not only possible, but it is also realistic to expect that at least some novice teachers design and carry out inquiry-based instruction. Novice teachers can be capable of articulating an emerging knowledge of teaching science as inquiry, and they may espouse philosophies aligned with this kind of pedagogy (Crawford & Lunetta, 2002; Windschitl, 2003), but they may be incapable of, or unwilling, for various reasons, to enact teaching science as inquiry in their classroom (McGinnis, Parker, & Graeber, 2004; Newman et al., 2004).

Levin, Hammer and Coffey (2009) provide an extensive review of the challenges to stage-based accounts of teacher development, indicating that this view may be misleading and steer teacher education in science in unproductive directions. They suggest that in a number of studies, pre-service teachers were able to reflect on several issues related to the content of teaching (Grossman, 1992), and to attend to the substance of their students' thinking (Davis, 2006), although Davis questions pre-service teachers' abilities to reflect-in-action. Despite stage-based accounts implying that after having developed classroom routines teachers focus their attention to student reasoning, Zeichner and Gore (1990) showed that novice teachers rapidly shift from progressive, student-centered attitudes formed during pre-service to traditional, teacher-centered approaches when confronted with the realities of the workplace. Furthermore, studies showed that teachers often become satisfied with their teacher-centered approach to teaching and are less likely to question their chosen routines (Grossman, 1992). Finally, Olsen (2007) indicates that such stage-based models focus on implementation and not necessarily on decision-making processes that take place during teaching and learning, and that such work has been primarily conducted with in-service teachers.

We agree with these challenges and we highlight that the ability to attend to students' inquiry is one of the critical aspects of the pedagogical content knowledge (PCK) that novice teachers need to develop as part of their pre-service preparation (e.g., Davis & Smithey, 2008). Even though helping pre-service teachers develop rich pedagogical content knowledge prior to substantial teaching experience is not an easy task (van Driel, De Jong, & Verloop, 2002). We agree with Davis & Smithey's suggestion that it is possible to provide pre-service teachers with enough experiences to prepare them to develop "PCK readiness" – that is the requirements for developing abilities to attend to their students' inquiry. Davis & Smithey use the following analogy to illustrate the idea of "PCK readiness": Kindergarten teachers spend most of the school year helping students develop "reading readiness" i.e., the skills students need to develop before they can read. None of these skills (how to hold a book, which direction to turn the pages, the letters and their sounds) is technically "reading," but every reader needs these skills. Similarly, they suggest that pre-service teachers can learn about the content, how to represent this to learners, and common ideas learners bring to the science class. Even if this initial knowledge is in pieces, this forms the building blocks for well-developed and usable PCK.

The idea of framing and how we transfer it to student-teaching

Though substantial gains have been made in understanding teachers' professional knowledge development (e.g., Munby et al., 2001; Calderhead, 1996; Borko & Putnam, 1996), little is known about the difficulties novice teachers encountered during teaching science as inquiry (Anderson, 2002), raising questions about how to support learning and to enact teaching science as inquiry (Newman et al., 2004; Windschitl, 2003).

To contribute towards this end, we have adopted the term "framing" based on previous work in sociology (Goffman, 1974), sociolinguistics (Tannen, 1993), and cognitive science (Schank, 1990). Framing is used to describe the idea that people use knowledge from past experiences to make sense of what is going on in situations they perceive to be similar. In this sense, individuals are accomplished at attending to what is happening around them, searching for signals that indicate the type of activity and making alterations to their behavior when it appears appropriate (MacLachlan & Reid 1994). For instance, when entering an unfamiliar restaurant people immediately interpret what kind of restaurant it is based on activities around them: Are customers waiting for a waiter to take their order or are they standing at a counter ordering food? In this manner framing influences one's expectations about what is going on as well as their interpretations of what they see or expect to happen in particular situations, so influencing the way they act.

We can parallel the manner people frame daily activities with the way pre-service teachers frame their role in science classrooms. There are many aspects to framing, including how to manage teaching time, maintain student control and introduce new activities. Additionally, the consideration of whether or how teachers respond to their students' inquiry may also be an aspect of framing. Their understanding of successful teaching should include the issue of responding to students' inquiry or not, and in which ways this is done. This perspective may help to better understand student-teachers' enactment of teaching during the early phases of their careers.

Our purpose in this paper was to describe how the a senior student-teacher conceived her role in the class and how her behavior reflected a struggle to balance between teaching science as implementing a prepared lesson plan, and as attending to her students' emergent inquiry, seeking to identify different ways of teacher acting during teaching. While it is inconceivable to focus only on implementing a lesson plan with total disregard of student inquiry in a student-centered setting, it is also "unacceptable" for a student-teacher to ignore an informed lesson plan. This dilemma has implications for what is seen as the role of science teaching preparation and how educators support their student teachers' struggle to balance both criteria. In this paper, we seek to show that the student-teacher was able to attend to her students' inquiry during her teaching early in her career, despite stage-based accounts of teacher development.

Methodology

This is an interpretive case study focusing on a single science lesson of a senior kindergarten student-teacher. We recorded and transcribed this lesson in March 2009 as part of the student-teachers' requirements to have five of their science lessons videotaped, which they subsequently reviewed and discussed with the faculty teaching science methods, their teaching supervisors and their peers.

For her last semester of student-teaching (Spring 2009) Mary (the study's participant) was assigned to an urban public kindergarten school and carried out her nine-week student-teaching practicum in a class of 17 students (age ranging: 4.5 - 5.5 years old). The lesson we analyzed for this paper was her first science lesson during this student-teaching phase and concerned the solubility of various substances in water. We chose to analyze this specific lesson because it was easy to identify instances in which Mary followed her lesson plan or not, as she had an elaborated version of her lesson plan and when following it she would literally read from it.

For this paper, we used the lesson video and its transcript as our primary data source. Using Videograph software, we coded all the episodes during which Mary talked during whole class discussions. The coding was based on whether she was following her lesson plan, or making "teaching moves" for which she had not planned. We used four codes for this analysis where Mary: (1) read directly from her lesson plan, (2) did not read from her lesson plan, (3) followed an open-ended discussion activity that she had planned for (that is she did not read from her lesson plan, but she was following a pre-planned activity) and (4) students talked. The coding was carried out by the second and third authors (Cohen's Kappa=0,945) and the resulted differences were resolved through discussion.

When agreement was reached, in order to have participant check of our interpretations of the findings, the first author carried out an open-ended interview with Mary, during which the video of the lesson was reviewed, pausing it at various points that had been selected based on the findings of the analysis. At those points, he asked Mary about her thinking and purpose for specific "teaching moves". In some cases, she requested to watch the episode under discussion once more. Eventually, she was able to identify the elements of the students' thinking to which she was responding. In this way, we verified or made alterations in our interpretations of the findings of the code-based analysis.

Findings

For about 14 minutes of the lesson (out of the total 42 of the entire lesson – 33.3%) Mary read directly from her lesson plan, obviously following an elaborately prepared plan. Out of the total 483 utterances coded, this time corresponded to 86 utterances (17.8%). We refer to these instances as working within an *implementing-a-lesson-plan frame* (Frame 1). Conversely, for about nine minutes, (21.42% of the total lesson time) Mary spoke spontaneously without searching to read what to say. This time corresponded to 125 utterances (25.87%). Within these nine minutes of spontaneous talk, we identified two distinct sub-frames where Mary either a) responded directly to her students' thinking or conversational contribution (*attending-to student-inquiry-frame* – Frame 2) or b) she was following an open-ended discussion with her students within her lesson plan's general structure (*lesson-plan free-talk frame* – Frame 3). The second frame consisted of 49 utterances (10.14%) and lasted for about 4 minutes (9.5% of the total time), and the third frame consisted of 76 utterances (15.73%) and went on for about 5 minutes (12.5% of the total time). The remaining 217 utterances corresponded to student talk in the conversations, while the time unaccounted for was taken up by the children's experimentation (about 9 minutes). Figure 1 represents a timeline graph of the lesson's discourse. From this it is clear that, while there are instances where Mary worked primarily within one of the three frames identified (e.g., utterances 0-13; 81-145; 416-449), there are also instances when she shifted to and from between the frames over a short period of time (e.g., 14-80; 140-231; 350-455). The analysis of the transcript and the subsequent interview with Mary, allowed us to define the characteristics of the frames identified. Below we describe in detail those characteristics for each of the frames we identified.

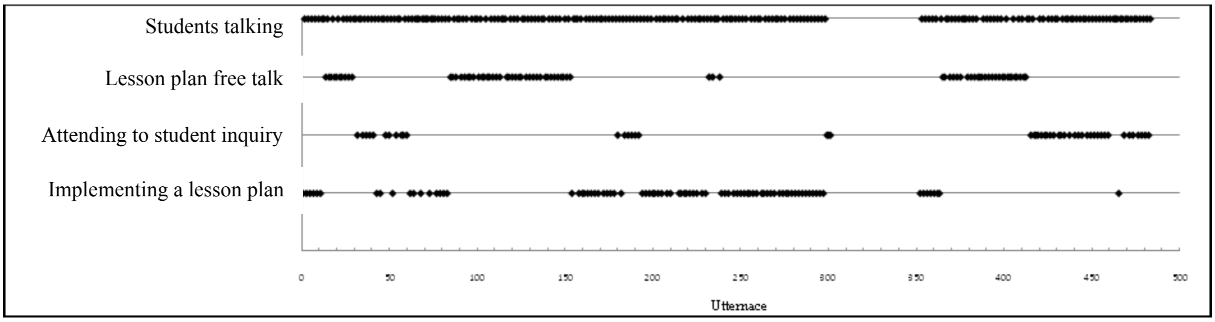

Figure 1. Timeline graph of the student-teacher's discourse

Working within the implementing-a-lesson-plan frame

For most of her teaching time, Mary worked within the implementing-a-lesson-plan frame. She began her lesson within this frame, and in almost all cases returned to this frame after having shifted to the other frames. From the interview, it was clear that Mary was very conscious of the fact that the lesson plan she had prepared included prescribed activities from the teacher's official guide for teaching science in kindergarten, and for which her tutor had given approval thus, she felt that "these are the steps we have been taught to follow". Her sense of urgency to fulfill each outlined step was also apparent as she proceeded with the sequence of activities, paying little attention to her students' responses and understanding. Her questioning, as she turned from one student to the next, was characterized by the search for the correct, predefined answer. The conversational exchanges that took place in this frame lasted longer than the other two frames, with each of her utterances lasting for an average of 10s – (the duration in frame 2 was about 5 seconds and about 4 seconds in frame 3.) Consequently, her questioning sessions during this frame labored for as long as it took to find the answer required. One of the most salient aspects of this frame was the jarring changes from one activity to the next when Mary felt she 'had' to move on.

In the example below we see Mary cutting short a discussion in order to move on to the next activity. This discussion, in which students were articulating their hypotheses relating to what had happened to the sugar in the water, was carried out in attending-to-student-inquiry frame. In this excerpt, Mary reverted back to the lesson plan's next activity (frame 1) without linking it to her students' on-going discussion, giving the impression that it was the lesson plan, not Mary 'running' the lesson.

Mary: Harry says the sugar fell into the water, so what might have happened to the sugar? [as it cannot be seen]
Student 1: It turned into water
Mary: What do you mean it turned into water?
Student 2: It melted
Mary: It may have melted…
Student 1: It became sugar
Mary: OK, now I am going to give you each something, OK? You can touch it, smell it, but you mustn't taste it, [hands out substances with which the children will experiment]

Working within the attending-to-student-inquiry frame

Our analysis showed that Mary shifted from following her lesson plan to directly responding to her students' thinking, and in this attending-to-student-inquiry frame, she did not read from her lesson plan. Rather, she attended and responded to her students' thinking, even if this led her outside of what she had planned. In these instances, she spontaneously provided her students with some feedback, comment or conversational direction that was not part of her lesson script. This frame usually lasted for short bursts of dialogue when Mary responded directly to her students' inquiry and then she quickly reverted to frame 1. For instance, after the children's various predictions of what would happen to the substances in water, during which Mary followed her lesson plan, the different children's predictions caused Mary to abandon her lesson script.

Mary: How can we be sure what is right? I see we have some disagreements… how will we know for sure if our materials will dissolve or not? What should we 'scientists' do?
Student 3: We can sit at our tables and see…
Mary: See what? Do what at our tables?
Student 3: Scientific things!
Mary: Scientific things! Well done, and what do we call these scientific things?
Student 4: Experiments!
Mary: Well done Nancy! We're going to do an experiment!

After this short discussion (frame 2) , Mary shifted back to following her prescribed lesson plan (frame 1) and brought out a chart for noting down the predictions prior the experiments. We suggest that the relatively brief duration of these exchanges in frame 2 (an average of 5 seconds per teacher utterance) was due to two factors. First, the fact that the dialogue during this frame was not part of the "official script" seemed to cause Mary anxiety and a desire to return back to the security of her lesson plan. Second, it became apparent during the interview that Mary somehow underestimated the real value of these activities regarding them as only perfunctory steps in the process towards understanding the concept of dissolving. Nevertheless, during this frame there was cohesion not only within the frame as Mary's questioning directly addressed the children's conversational contributions, but also as she moved from this frame to a different one. These moves were characterized by a natural flow which did not disrupt the rhythm of the lesson nor disorientate the children.

Working within the lesson-plan free-talk frame

During analysis we identified a third, somewhat intermediate, frame to the previous two. This frame was observed (1) during the discussion of the problem presented (where was the sugar which had fallen into the water?), (2) while the children identified the materials with which they would experiment, and (3) immediately following their experiments, when they announced their results to the rest of the class. In this lesson-plan free-talk frame, Mary also responded to the children without reference to her lesson plan, but on these occasions she was clearly working within a particular activity she had noted previously as a sub-heading but had not scripted for in the lesson plan. She responded less specifically to the children's conversational contributions compared to the second frame, often reflecting their answers back at them when these were wrong (e.g., "is it sugar?") or repeating their correct answers, meanwhile using more closed questions than when working within the attending-to-student-inquiry frame. This frame always followed on from the implementing-a-lesson-plan frame and it was apparent that Mary was aware of the pedagogic objective for these activities which, to some extent restrained her responses to students' inquiry in her attempt to fulfill the objective. On two occasions, when she moved from this third frame to the attending-to-student-inquiry frame, this occurred when the children encountered difficulties in responding appropriately to Mary's more restricted questioning and Mary seemed to instinctively and effortlessly change her framing to accommodate for this factor and respond directly to the children's comments, building on these comments to guide the children in their discovery.

The following is a short excerpt in which the children announced their conflicting results for whether flour dissolved in water or not. In this excerpt, Mary shifted from working in the lesson-plan free-talk frame (during which she guided students to present their results) to attending-to-student-inquiry frame.

Mary: Let's look at your results for flour. What happened to the flour? Did it dissolve or not dissolve?
Student 5: It dissolved!
Student 2: No, it didn't dissolve!
Mary: What did you discover? Let me come and see [what they had noted on their charts]
Student 1: We discovered that sugar….
Mary: But what happened to the flour now. […] Did it [the flour] dissolve or not?
Student 1: It dissolved.
Mary: Has another team noted something different? Do you agree?
Student 4: Andy's team discovered that it didn't dissolve.

While working within a lesson-plan free-talk frame for some time, Mary "saw" that at least two groups of students had different results for whether the flour dissolved in the water or not. A possibility is that this disagreement is related to how one defines solubility (e.g., something is considered dissolved if it is not visible any more, or when one cannot identify two separate substances). While Mary did not clarify this definition, she addressed the disagreement between the groups, because, as she indicated in the interview, students acting as scientists need to reach consensus about an experimental result. To do that, she shifted to the attending-to-student-inquiry frame. Mary also indicted that when she reverted back to following-the-lesson-plan frame, it was specifically to move to the next activity in the lesson either guided by time restraints or believing that she had fully addressed the children's questions. These moves back to the following-the-lesson-plan frame were marked by abrupt changes in the discussion's direction and lesson activity.

Themes emerged across the three frames

Despite the differences between the three frames that we described above, we have identified at least two emerging themes relevant to all the frames. These include Mary's need for "teaching security" and her role in the classroom, which we describe below.

Mary explained that the lesson plan offered her security by knowing "where [she was] in the lesson and how to proceed." She indicated that "I feel secure that I know now I do this and then I do that." This had an impact on the duration of the various activities: During the lesson implementation, Mary felt justified to allow e.g., the questioning to last for a long time, until the children gave the 'correct' answer, resulting in her paying little attention to alternative answers offered. Conversely, she was aware of the time pressure during the frames outside of the lesson plan stating emphatically, "the discussion flowed and the lesson progressed but it took too long." Her view that these activities did not contribute substantially to the learning added to her need to return to the safety and validity of the lesson plan, and was evident in her abrupt jumps from the lesson-plan free-talk back to the implementing-the-lesson-plan frame.

Mary also indicated that while working within the implementing-a-lesson-plan frame she "just let the lesson plan roll and didn't respond to them [her students]", supporting our own findings that in this frame Mary "automatically" moved from one activity to the next. She conceived her role as following an approved plan, and thus her main concerns were to finish the activities culminating in the correct answer, though she described her role as that of a guide, providing the stimuli with which to develop the children's knowledge and discovery in the direction she saw as relevant. In contrast, while working within the attending-to student-inquiry-frame or the lesson-plan free-talk frame, she indicated that the children had made comments she had not predicted and thus responded intuitively addressing the issues raised. Likewise, when asked why she had not scripted for all the activities in the lesson plan, she said that during these activities "I knew [what needed to be done]".

Discussion

Our purpose in this study was to describe in detail a science lesson of a senior kindergarten student-teacher in order to gain better understanding of how she conceived her role in the class and how her behavior reflected a struggle to balance between teaching science as implementing a lesson plan she had developed and received approval for by her tutor, in contrast to attending to her students' scientific inquiry.

Our first contention is that our findings show that the idea of "framing" (Goffman, 1974; Tannen, 1993; Schank, 1990) as a methodological approach used for analyzing teaching may prove useful in understanding the processes that novice teachers go through during their first attempts to teach. Framing is used to describe the idea that people are accomplished at attending to what is happening around them by searching for signals that indicate the type of activity and making alterations to their behavior when it appears appropriate (MacLachlan & Reid 1994), and by using past experiences to make sense of what is going on in situations they perceive to be similar. This helped us define different ways of teacher acting during teaching and their characteristics and so identify several issues that caused Mary's struggles during student-teaching in science.

The need to follow an approved lesson plan, to feel confidence in what she was doing, the restriction of the time, and her understanding of her role as a teacher in the classroom were some of the factors that guided Mary's behavior during the lesson we analyzed.

Second, we argue that it is not unrealistic to expect novice teachers to be able to attend to their students' inquiry during actual teaching. Despite views suggesting that novice teaches may be incapable of enacting teaching science as inquiry (e.g., McGinnis, Parker, & Graeber, 2004), our findings suggest that the student-teacher in this study was able to attend to her students' inquiry at times and successfully integrate aspects of teaching science as inquiry into her teaching. Of course, we do not suggest that she was expert in teaching science as inquiry, in fact, there are several respects in which it is evident she was not. Our conclusion, then, is that novice teachers come to their student-teaching with some possibly nascent abilities for inquiry teaching, that they may invoke these spontaneously, directly in line with the abilities that teacher educators have described as important to impart. That Mary actually shifted frames, suggests having the ability to make these transitions. From the interview it was clear that these shifts were not always done consciously, but intuitively.

Agreeing with challenges to stage-based accounts of teacher development (e.g., Levin, Hammer & Coffey, 2009; Grossman, 1992; Davis, 2006; Sherin, 2004), we suggest that an important role of undergraduate methods courses is to help students make clear distinctions between alternative teaching frames, understand the different interpretations of teaching within each frame and the characteristics of the teaching resulting from each. At the same time it is important to help pre-service teachers develop strategies both for (a) entering the attending-to-student-inquiry frames during early stages of their careers, and (b) working within that frame more reliably. This will help pre-service teachers to develop "PCK readiness" (Davis & Smithey, 2008) which they can then use for developing abilities to attend to their students' inquiry.

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