Chapter 5
Using Self-Study to Evaluate a Pedagogical Approach for Navigating Conflict in a Science Content Course for Preservice Teachers

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Introduction

Teachers face conflicts in their classrooms and take on the role of problem solver. When issues are encountered, teachers often act in the moment: diagnosing a problem, determining a course of action, and enacting this response. Without devoting time to ascertain the nature of a conflict, however, these immediate reactions may not address the actual problem. Teachers need to reframe a problem prior to taking a particular course of action (Cuban, 2001). Through this process, teachers assess and appropriately modify their practice, thus enhancing their professional knowledge.

This self-study describes a conflict, which arose in my (second author) science content course for preservice elementary teachers, and my use of self-study in response to the situation. The conflict centered on the drastically different views held by me, the teacher educator (TE), and the preservice teachers (PSTs) regarding the quality of work completed by the PSTs on a course assignment. Rather than overlooking the conflict and continuing with the curriculum schedule, I chose to critically examine my practice by exposing my assumptions, identifying the underlying sources of the conflict, and evaluating the effectiveness of the pedagogical approach used to navigate the conflict.

The present chapter provides a theoretical framework which grounds the research in teacher identity development, describes the methodology employed to examine my practice, and shares findings, which contribute to the pedagogy of science

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teacher education. Specifically, the chapter describes my use of reflection activities as a mode of inquiry to understand the problem from multiple perspectives, to assist in navigating the classroom conflict, and to identify and manage the tensions in my practice.

Theoretical Framework

Identity can serve as a theoretical framework to understand the developmental stages through which PSTs progress for the purpose of guiding TEs' course design and instructional decisions. In other words, the TE can make informed decisions of when and how to adjust his practice to accommodate the PSTs' current positions in the progression of their professional identity development. There is a significant body of research with respect to identity generally falling into two different camps: the psychological development of self and the social development of identity (Roeser, Peck, & Nasir, 2006). For the present self-study, as recommended by Hamman, Gosselin, Romano, and Bunuan (2010), the TE examined his practice while considering his PSTs' development in the context of the social construction of identity. In particular, two constructs are integrated: possible selves (Markus & Nurius, 1986) and figured worlds (Holland, Lachicotte, Skinner, & Cain, 1998). In conjunction, they guided the structure of the aforementioned course, which focused on developing teacher knowledge, a critical component of teacher identity. Further, throughout teacher identity development, PSTs encounter various obstacles. The nature of such obstacles offer insight into how TEs can modify their practice to help PSTs continue in their professional identity development.

Identity is the way in which someone perceives oneself (Horn, Nolen, Ward, & Campbell, 2008). Therefore, a teacher's identity reflects the views of oneself as a teacher (Lasky, 2005). These images are evolving and are influenced by PSTs' experiences as a student and their coursework, fieldwork, and student teaching during their teacher education program (TEP). PSTs negotiate their teacher identity as they integrate these experiences. This negotiation involves the development of a collection of potential teacher identities or possible selves. Possible selves stem from a person's past and reflect views of oneself in the future incorporating one's purposes, hopes, and concerns (Markus & Nurius, 1986). Although there have only been a few efforts to use the theory of possible selves in the context of the identity development of teachers, Hamman et al. (2010) argue that the theory is particularly applicable to individuals new to the field as they transition from student to teacher.

In TEPs, PSTs are in the process of developing a professional identity, which, in contrast to possible selves, is a more consistent view of oneself as a teacher (Ibarra, 1999). To transition to this more established professional identity, PSTs experiment with provisional selves (possible selves that are actually explored) (Ibarra, 1999). At first, the provisional selves are responses to new experiences and expectations as PSTs progress through their TEP; some of the provisional selves are incorporated into PSTs' professional teacher identity (Ronfeldt & Grossman, 2008). Ronfeldt

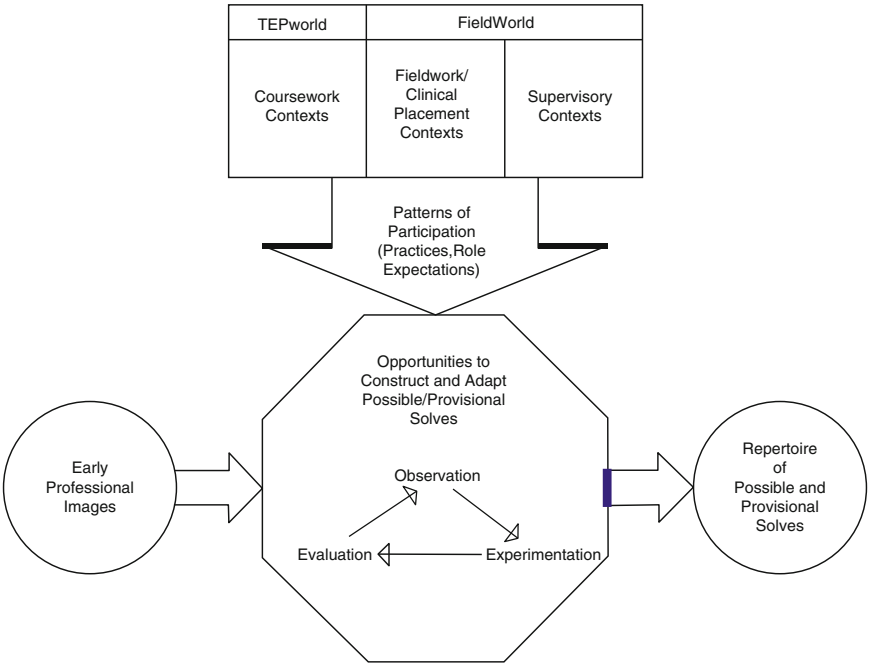

Fig. 5.1 Modification of model of the identity adaptation process for preservice teachers (Ronfeldt & Grossman, 2008, p. 43). [Used with permission of Caddo Gap Press.]

and Grossman (2008) adjusted Ibarra's (1999) model of the identity adaptation process for business professionals to show this transition for PSTs (Fig. 5.1).

The model reflects the process of PST identity development during a TEP. The circle on the left represents the early professional images that PSTs bring with them to their TEP and have been developed through their years of experiences as students, which Lortie (1975) calls the *apprenticeship of observation*. The top three rectangular regions represent the different components of TEPs (e.g., coursework, fieldwork, and student teaching). These three components along with the early professional images result in the development of possible selves through observation. The possible selves are tested through *approximations of practice* such as role playing in course work, working with a small group of students in a field experience, or taking over instruction during student teaching (Grossman et al., 2009). The PSTs then evaluate these provisional selves through self-assessment and feedback from others. As PSTs complete their TEPs, they enter the teaching field with a set of possible and provisional selves that they have gained via the repeated, cyclic process of observation, experimentation, and evaluation.

One of the challenges that PSTs face during this identity development process is the contradictions that exist between coursework and field placements (e.g., Feiman-Nemser & Buchmann, 1985; Horn et al., 2008; Smagorinsky, Cook, Moore, Jackson, & Fry, 2004; Walshaw, 2004; Wideen, Mayer-Smith, & Moon, 1998). For example,

a methods course in science may promote inquiry-based learning; however, in the field, students observe teachers using a direct-teach model. The two settings represent different *figured worlds*; that is, each is a sociocultural space with its own distinct set of norms, goals, and values connected to the role of the teacher and the act of teaching (Holland et al., 1998; Roeser et al., 2006).

Horn et al. (2008) label these two worlds as the teacher education program world, or TEPworld, which represents the coursework component, and the FieldWorld, which represents the field experiences of a TEP. As demonstrated in the previous example, Horn et al. found that the methods to which the PSTs are exposed in the TEPworld were not necessarily in alignment with, or a feasible practice in, the FieldWorld. However, navigating the contradictions between the two worlds had the potential of resulting in learning. The PSTs who successfully negotiated the contradictions between the two worlds, or experimented with possible selves, built a collection of provisional selves in the development of their professional identity. On the other hand, PSTs, who did not experience challenges or encountered too much frustration and gave up on the practices promoted in the TEPworld did not have the opportunity to try out possible selves and reduced their opportunity to reflect upon and revise their practice. The underlying message is that challenges, monitored by TEs, are a critical part of learning, or professional identity development.

The focus of research with respect to identity development changes, and is influenced by, the career stage of a population of teachers (i.e., PSTs, student teachers, novice teachers, etc.) (Beijaard, Meijer, & Verloop, 2004; Rodgers & Scott, 2008). The aforementioned research concentrates on the obstacles to identity development of PSTs who were well into their TEP and were already experiencing the FieldWorld; that is, they were simultaneously residing in both regions at the top of Fig. 5.1. The challenges that these PSTs face are distinct from those they experience at the outset of a TEP as they only reside in the top left region of Fig. 5.1. Since the PSTs are just entering the TEPworld, their repertoire of provisional selves is minimal and most of them stem from one source, their experience as K-12 students. By contrast, later in the TEP, their provisional selves derive from multiple sources including experiences as a student, TEP course work, and field experiences. In addition, the PSTs have not yet entered the repeated cycles of constructing, experimenting, and evaluating provisional selves. Little research in the area of identity development has been conducted with PSTs at this early stage of their TEP.

Ma and Singer-Gabella (2011) acknowledged this need to examine how PSTs with minimal exposure to teacher professionals start to build a collection of provisional selves. Specifically, they used the framework of figured worlds to explore PSTs' identity development while they were enrolled in a mathematics course for elementary teachers. Unlike the participants in the Horn et al. (2008) study, these PSTs had limited access to the FieldWorld. The PSTs were exposed to the figured world of reform mathematics pedagogy exemplified by high-level tasks, which require active engagement of students in problem solving and communicating their reasoning. In this context, the instructors positioned the PSTs, through approxima-

tions of practice, sometimes as learners and other times as teachers of mathematics. Ma and Singer-Gabella (2011) found that while some PSTs willingly assumed the different roles, others resisted and maintained the identity of a student in a college course.

The struggles in helping the PSTs start to take on a teacher identity described in the Ma and Singer-Gabella (2011) study reveal the induction into the TEPworld from the StudentWorld (Quebec Fuentes & Bloom, 2011). The StudentWorld has two components; it consists of the PSTs' past educational experiences, termed the RealWorld (Horn et al., 2008), and the PSTs' role as student in a course. The PSTs' StudentWorld experiences influence their identity development in two ways. First, the initial repertoire of provisional selves brought to a TEP by the PSTs is limited to their experiences as students. Second, many PSTs new to a TEP have not been expected to simultaneously participate in a course as a university student and to consider the classroom activities from the perspective of a teacher.

Expecting the PSTs to take on dual-roles in such a class, as they work towards developing their professional identities, presents challenges that can result in various tensions in the TE's practice. Berry (2007a, 2007b) proposes a conceptual framework, centered on tensions, for the practice of TEs. In the context of teacher education, Berry (2007a) describes tension as the "internal turmoil experienced by teacher educators as they found themselves pulled in different directions by competing pedagogical demands in their work and the difficulty they experienced as they learnt to recognize and manage these demands" (p. 119). Through self-study of her practice as a biology TE, Berry identified six tensions. Although articulated as six unique tensions, multiple tensions may be evident in an incident. For instance, the present self-study exemplifies the confluence of three tensions: *safety and challenge*, *telling and growth*, *confidence and uncertainty*.

Telling and growth refers to the tension that exists as a TE struggles with the desire to tell the PSTs what they need to know about teaching, and alternatively providing opportunities for the PSTs through which they can personally build an understanding of the complex nature of teaching and learning. Further, early in TEPs, PSTs can possess a limited repertoire of possible selves, which is primarily informed by their experiences as a student. As such, TEs can experience tension regarding how to adopt a pedagogy that is contrary to what PSTs might expect and may seem unfamiliar and challenging to them. Utilizing a new and unfamiliar pedagogy can result in another tension: *safety and challenge*.

Safety and challenge refers to the tension that a TE must manage when challenging PSTs with learning activities that confront their preconceived perceptions of teaching and learning. The TE must simultaneously balance challenging experiences with a safe environment so that the PSTs can successfully navigate through and learn from the discomfort. If the TE provides too safe an environment, PSTs are denied experiences through which they can demonstrate learning. Alternatively, if the environment is made too confrontational, PSTs can shut down and learning will cease. However, if the TE successfully manages this

tension, the challenges can be valuable learning experiences (Daloz, 1999; Horn et al., 2008; Kegan, 1994).

Confidence and uncertainty refers to the tension TEs experience when exposing their vulnerability, while dealing with the messiness of teaching, and also maintaining the PSTs' confidence in them. Uncertainty is inherent in trying novel pedagogical approaches, and should be exposed to PSTs. However, TEs must demonstrate confidence in light of such uncertainty to maintain the trust of the PSTs during the experiences. In this way, TEs model to the PSTs how to maintain confidence in their own ability in light of the messy and complex nature of teaching.

These three tensions were revealed through the conflict that occurred in my science content course for preservice elementary teachers, early in their TEP. The purpose of the present self-study is to examine how I changed my practice in response to the conflict. The overarching question addressed was: How can I use reflection activities to navigate the conflict? In order to address the conflict and assess my practice, I also needed to answer the following subquestions: (1) What were the underlying sources of the conflict? and (2) In what ways did my change in pedagogical approach help resolve the conflict?

Methods

Self-study has developed in response to the need for teacher educators to examine their own practice of teaching about teaching (Loughran, 2005). It is influenced by and has emerged from other domains including practitioner research, action research, and reflective practice (Russell, 2004) and examines "the learning from experience that is embedded within teachers' creating new experiences for themselves and those whom they teach" (Russell, 1998, p. 6). Self-study is considered a methodology, and, although there are no specific guidelines to follow (Loughran, 2005), self-study has various defining characteristics. The impetus for action in self-study is the contradictions sometimes found between what one intends and the reality of one's experiences (Loughran & Northfield, 1998). Self-study methodology focuses on improving/transforming practice through reflection substantiated through the analysis of data. It is personally situated in one's own classroom teaching and involves interaction with past experiences and literature as well as collaboration with peers and PSTs. Further, self-study utilizes rigorous and transparent qualitative methods establishing the trustworthiness of the findings. Last, self-study research should be made public so as to contribute to the pedagogy of teacher education (LaBoskey, 2004; Samaras, 2011). The present study meets these criteria.

Context and Participants

The self-study was focused on my practice in a science content course for preservice elementary teachers. My course objectives were to increase PSTs' science content knowledge for teaching; to develop PSTs' ability in accessing, interpreting, and assembling science content knowledge from various sources for use in instruction; and to allow the PSTs to engage in approximations of practice through peer-teaching. In repeated cycles, I engaged the PSTs in specific scientific topics (e.g., tsunamis/earthquakes and ecological food webs) via film clips, Youtube videos, children's books, or other media. After each engagement, I challenged the PSTs to investigate the topics further by responding to guiding, open-ended prompts and questions. The PSTs used Internet searches, textbooks, and other academic resources to inform their investigations. Working in groups, the PSTs explored the topics and prepared presentations of what they learned. For each investigation cycle, one group was selected to present their findings to the class and answer questions that arose from the other groups and me.

Science for Elementary Teachers was a required course for preservice elementary teachers prior to their official entry into the College of Education. Traditionally, PSTs enter the College in their junior year and, therefore, most of the PSTs in this study were enrolled in their freshman or sophomore year. This course often marked the PSTs' first interaction with the College of Education, as it was one of their first education courses.

At the time of the current study, there were 24 female PSTs enrolled in the course. I was in my third year of teaching within the TEP. Prior to this position, I had over 9 years experience teaching in colleges of science and engineering. Along with Science for Elementary Teachers, I also taught methods courses for elementary, middle, and secondary science and graduate level education courses. In addition, I had over 7 years experience conducting professional development for elementary, middle, and secondary science teachers. I personally designed and developed the course, Science for Elementary Teachers, and, during the current self-study, was teaching it for the fourth time.

Data Sources and Analysis

I used multiple data sources to evaluate my practice; seek out my assumptions, which were contributing to the conflict; and allow me to make improvements to my practice in order to manage the conflict. In this section, I briefly summarize each of the data sources and provide the general storyline of the study. In the subsequent sections of the chapter, I elaborate on the events that occurred and include more details about the various data sources.

- PST Coursework: PSTs completed group reports on specific science content areas stemming from prompts that I provided. One of the investigations, the

center of the conflict, is presented in detail later in this chapter. For each investigation, the members of one group presented their understanding of the content to the class. Throughout the semester, I assigned six investigations.

- PST Journal Responses: PSTs responded to two sets of reflective prompts. I assigned the first set of prompts immediately after the conflict surfaced to elicit the PSTs' perspectives about the conflict. I assigned the second set of prompts later in the semester to assess any change in perspectives. Both sets of prompts appear later in the chapter.
- Class Discussions/Activities: I modified my course plan to navigate the conflict. Specifically, I conducted two whole-class discussions to debrief on the PSTs' responses to each set of reflective journal prompts. Between the two journaling assignments, I designed and implemented three activities to address some of the core issues surrounding the conflict.
- Class Sessions: All class sessions, including the investigation presentations, whole-class discussions, and course activities, were documented through fieldnotes and video recordings. I used the transcripts of the video recordings as evidentiary documentation of the events that occurred throughout the course.
- TE Journal: After examining the PSTs' responses to the first set of journal prompts, I documented my thoughts via journal writing. In particular, I responded to the PSTs' perspectives about the conflict by considering my views, assumptions, and practices.
- Peer Consultation: My colleague (first author) served as a critical friend. She taught the corresponding mathematics education courses for the same population of PSTs and was, therefore, familiar with the PSTs' development throughout the TEP, my course, and its underlying philosophy. She brought a unique perspective to examining the conflict since her background was in a different content area. I engaged in frequent conversations with my critical friend about the conflict, the PSTs' perspectives, the tensions that emerged in my practice, and my pedagogical decisions and the outcomes of those decisions.

The self-study progressed in an iterative fashion using data analysis to continually identify the conflict between my PSTs and me and inform and evaluate the changes in my practice namely the subsequent reflection activities that I employed to mediate the conflict. The self-study initiated after a conflict arose between the PSTs and me, in response to one content investigation. I asked the PSTs to reflect upon their work and respond to a set of journal prompts. In collaboration with my critical friend, I evaluated the PSTs' journal responses in order to identify the nature of the conflict. At the encouragement of my critical friend, I reflected upon my part in the conflict, examining my own perceptions. I used reflective journaling to scrutinize my teaching practices, my assumptions, and my approaches to dealing with the conflict. A deeper understanding of my perspectives, and those of the PSTs, informed my instructional decisions about class discussions and activities. After implementation of these modified practices and subsequent content investigations, I asked the PSTs to complete another journal response, which was analyzed to identify and document the implications of the changes in my practice.

My critical friend and I utilized the constant comparative method (Glaser & Strauss, 1967) to analyze the PSTs journal responses. To initiate the analysis, we, along with three graduate students, each read a subset of the first set of journal responses in order to identify preliminary codes. Two analysts coded each of the 24 journal responses. After coding, we all discussed and refined the codes, identifying three salient themes: grades, components of a quality response, and need for guidance. My critical friend and I then re-analyzed all 24 sets of journal responses using the identified codes. I then utilized the identified codes and themes to frame my own journaling about the conflict and my pedagogical choices for the course. In addition to the codes that stemmed from the analysis of the first set of journal responses, my critical friend and I identified new codes in the process of analyzing the second set. The codes fell within two different continuums: understanding instructor expectations and developing teacher identities.

Since self-study has roots in action research, I utilized Anderson, Herr, and Nihlen's (2007) validity/trustworthiness criteria. For example, I established *dialogic validity/trustworthiness* through consultation with my critical friend. By soliciting the PSTs' perspectives and considering them in light of my own, I met the criteria for *democratic validity/trustworthiness*. Instead of merely identifying the problem, I adjusted my practice and evaluated the changes I made to ensure that I addressed the conflict; these actions achieved *outcome validity/trustworthiness*.

Learning Through the Self-Study Process

Prior to the Conflict

As discussed, the major assignments of the course were cyclical content investigations that were assigned to small groups of PSTs. My journal about the course describes my expectations for the PSTs' improvement on these assignments over the semester:

> When it comes to measuring student learning, I do not focus on individual assignment grades, but rather pay attention to the quality of the student work over time as indicative of how the students are growing in their ability to meet course objectives … In addition to the grades, written comments throughout the reports indicate when and how expectations are met or exceeded. Conversely, when expectations are not met, comments indicate how responses are deficient, and suggestions for improvement are offered. … my ultimate goal was for them to exceed expectations and produce elegant knowledge packets that reflected the knowledge needs of teachers.

The initial investigation focused on hurricanes, and I used it to introduce the PSTs to the investigation cycle. To engage the PSTs in this investigation, I drew upon a local newscast weather report that was describing the ongoing storms resulting from a current hurricane forming in the Gulf of Mexico. I then gave the PSTs a series of questions about hurricanes for them to investigate (e.g., How do hurricanes form? Where, globally, are hurricanes most common? What causes "hurricane season?").

For the second investigation, I showed the PSTs a clip from *Finding Nemo* (Stanton & Unkrich, L. (Directors), 2003) that depicted a variety of ocean animals living in a community. I assigned each group of PSTs a different organism and provided prompts to guide their research (e.g., Describe the life cycle of your animal. What characteristics help your animal survive in its environment?). For each investigation, the PSTs submitted a group report. On these reports, I provided feedback in the form of questions and comments to encourage the PSTs to go into greater depth (or breadth) when their answers were too simplistic (or narrow in focus). For example, in response to a group's description of ocean life, I probed the PSTs' thinking with questions such as "What makes anemones 'plant-like'?" and "What are the different stages of a shark's life cycle?" and criticized their work with comments such as "This doesn't give me a greater understanding." My goal was for the PSTs to read these comments and allow them to guide their preparation of subsequent investigations.

The Conflict

For the third investigation cycle, I engaged the class with a video and reading of *The Very Hungry Caterpillar* (Carle, 1969). Similar to the second investigation, I asked the PSTs to describe general life cycles and characteristics of a species. In contrast, the third investigation focused on a single species: the monarch butterfly. Additionally, PSTs needed to explore a new concept: metamorphosis. Specifically, the prompts for the Monarch Investigation were:

1. Describe the life cycle of the monarch butterfly.
2. Where do monarchs live?
3. How long does a monarch butterfly live?
4. Describe the migration of the monarchs.
5. Why do monarchs migrate to their winter location?
6. What specific foods do monarchs eat?
7. How does a monarch caterpillar turn into a monarch butterfly?
8. Is there anything special you would like to share about monarchs?

The results of this investigation did not reflect growth in the PSTs' ability to develop content knowledge for teaching that I expected at this point in the course. Their answers lacked content depth and included clear misconceptions. For instance, the following Monarch Investigation response demonstrates a lack of content depth:

> The change from a caterpillar to a butterfly takes place through the process of metamorphosis. The caterpillar will attach itself to a stem or leaf using silk and transform into a chrysalis. The chrysalis state of the life cycle, which is ten days long, is where a lot of change takes place, even though it is not apparent from the outside. During this stage, metamorphosis takes place, which is the transformation from a caterpillar to a butterfly. They build a cocoon, or chrysalis, where they hang upside down as they change into a butterfly. The chrysalis' color changes, as the caterpillar inside becomes a monarch. It goes from green to

> brownish, reddish, and lastly an orange color. Dramatic changes occur inside the chrysalis. The mouth parts must go from being those required for chewing, to what a butterfly will need: a straw-like tongue used for sipping nectar from flowers. And a crawling insect will become a flying insect during this stage. Butterflies are one of the most beautiful insects on earth and it is amazing that they make this transformation within days. (PSTs 2, 7, 13, 16, and 24)

The PSTs clearly attempted to construct a quality response to the prompt. They identified the process of metamorphosis, named a critical stage of metamorphosis (the chrysalis), emphasized two structural changes that occurred during metamorphosis (regarding feeding and locomotion), and described observable color changes that occurred during the process of metamorphosis. However, the PSTs did not adequately address the seventh prompt: to explain the process of metamorphosis. Had I failed to communicate the overarching purpose of the investigations?

In addition to lacking content depth, other responses demonstrated misconceptions. One group's response to the fifth prompt exemplifies one such misconception:

> The nectar supply shrinks as the air gets colder, and as this is the butterflies' main source of food, they need to leave. They are cold, and hungry, so they make the journey to where their food sources and climate will benefit themselves. Eggs will not hatch unless the weather is warm enough, because they are cold-blooded. (PSTs 8, 15, and 21)

The PSTs indicated that monarchs could not survive cold winter temperatures, when in actuality, they spend the winter months hibernating in high altitude forests where temperatures often drop to freezing or below. While the PSTs' response did explain the initial cause behind migration (following food sources), the response did not to accurately describe the final migratory location.

The group presentation of the Monarch Investigation was the flash point of the conflict. I was dissatisfied with a lack of content depth and the presence of many of the aforementioned misconceptions. Throughout the entire presentation, I repeatedly interrupted the presenters with questions. As the presenters described the stages of the life cycle of the Monarch butterfly, I interjected: "Can I stop you? … I think there could be misconceptions fostered by what you are saying." A lengthy conversation ensued during which I pushed the PSTs to explain what is occurring in the chrysalis: "So, I'm the caterpillar … I am wrapped up in this chrysalis … So, I dissolve? …I turned into liquid? … So, my arms just fall apart? … My appendage just disintegrates?" After peppering the PSTs with questions, I allowed the presenters to continue, and they turned the focus to the migratory pattern of the Monarchs exposing a misconception:

> PST11: Like other animals and insects, they avoid cold weather, so that's why they migrate, to go to warmer weather.
> TE: Tell me again, about warm weather; what about warm weather?

The remainder of the presentation proceeded in a similar fashion. At the close of the presentation, I inquired: "First off, what's going on today? What happened to you all today?" I expressed my perspective on the quality of the PSTs' responses: "I thought the answers were really weak compared to what we've had on the previous

investigations." I also acknowledged the feeling of frustration on the part of the PSTs: "You're resistant, you won't talk." In response to these questions, PST 22 explained: "I think maybe the group who was presenting might have been a little intimidated because of you. … Because you asked so many questions and jumped on them so fast." Near the close of the conversation, I shared: "I want to go back and reflect upon what we have presented … what your tasks are … so, what I've decided to do is turn this into a reflection on my teaching. … So, with that being said … I've got to totally regroup and figure out what we do for [the next class]."

Examining the Conflict

Instead of proceeding with another investigation cycle, I decided to examine my practice to see how it contributed to the conflict beyond the surface features that manifested during the Monarch Investigation presentation. Moon (1999) suggests the use of reflection to clarify the source and examine the nature of a conflict. The PSTs, in collaboration with me, engaged in critical reflection through journal writing and class discussion. Utilizing a structured approach to journal writing (Moon, 1999), I constructed an initial reflection activity, in lieu of an investigation, consisting of five prompts to which the PSTs responded:

1. How did you feel about the way we graded the first two investigations?
2. What do you think went awry with the Monarch investigation?
3. How did my reaction (and the subsequent conversation) make you feel? More anxious or more at ease? More comfortable or less comfortable? Other?
4. How confident are you now that you know *how much* needs to be in the answers to your future investigation questions? Explain your answer.
5. What do you think about rubrics in relation to our investigations? Could they be used? If so, how? What would they look like? Explain your answer.

The PSTs' responses provided material for me to reflect upon while documenting my perspectives in my journal.

In some of their responses, the PSTs confirmed their frustration and lack of security stemming from Monarch Investigation presentation.

- I definitely feel like you and [the teaching assistant] are disappointed in us. (PST 2)
- At first I was really uncomfortable and nervous that my investigation wasn't up to the standards that you wanted. (PST 5)
- I felt extremely frustrated just because I had worked hard on the monarchs and just felt as if I was not working hard in the way you wanted. (PST 12)
- If I was up there I would have been feeling uncomfortable because my answers were being questioned. (PST 13)
- I feel that the question asked by [the TE] makes students feel stressed, like they are doing something wrong. (PST 14)

- Your immediate reaction made me feel very inadequate and sort of awkward. (PST 22)

While the PSTs' comments indicated that my immediate reaction was causing feelings of insecurity, the overarching positive and informative outcome from the initial reflection activity was my recognition that my view of the PSTs' role in the class was clearly distinct from their own. Identifying these divergent perspectives regarding the PSTs' and my expectations of the course and the course assignments allowed me to recognize sources of the conflict.

Grades

I perceived the role of the investigations as iterative opportunities for the PSTs to develop their skills at building knowledge packets for teaching elementary students. As such, feedback on PSTs' reports was intended as constructive and helpful. As I wrote in my journal: "I value the academic exchange between student (via classroom deliverables) and teacher (evaluation of them) as integral components to teaching, not as a punitive measure to devalue students who do not fully achieve my expectations." However, my objective for providing feedback was confounded by the fact that the PSTs also earned a grade on the investigations.

The PSTs' responses indicated that, despite my intentions, they were focused on their grades instead of the quality of their work that led to the grades; the latter of which would have helped them demonstrate growth in their future work and develop toward the course goal. Being graded on what was intended as a learning opportunity, the PSTs were naturally concerned about not receiving higher scores on their reports: "On the second investigation we also received a B even though in my opinion we had more than enough information and I consider our investigation #2 to be at least an A-" (PST 10). The PSTs knew they were going to be evaluated based on their performance on the investigations; one PST conveyed her concern:

> [I am] feeling really anxious about this class in general right now because I don't know what to expect as far as grading and in-class activities. I was surprised when you said that we did so much worse investigating monarchs, and I am very nervous about my grade in the class because I really want a good grade but don't really understand how to get one. (PST 24)

Based on this and similar comments, I realized that I had made the faulty assumption that the feedback given on previous assignments was providing the guidance that the PSTs needed to develop their understanding of how to adequately prepare an investigation report.

Components of a Quality Response

In my journal, I explained my expectations with respect to aspects of a quality response:

> When I evaluate the investigation reports, I look for evidence that students have developed a sophisticated understanding of the content sufficient to teach it to young learners. This, of course, entails much more knowledge than is included in student learning materials (e.g., textbooks) or what they will expect the elementary students to learn. Additionally, their answers must demonstrate an ability to critically evaluate sources of information (for accuracy and reliability) and to determine the appropriateness of the content for their teacher knowledge. To do this, they must be able to take highly varied sources of information, find the content that is pertinent and useful for conveying the overarching ideas, and construct a response that logically, cohesively, and concisely demonstrates their conceptual understanding. For example, a textbook may depict the annual migration of monarch butterflies from Canada to Mexico, but fail to explain what drives the movement … A teacher should understand the annual migration of monarchs sufficiently to link this phenomenon with changing seasons, weather patterns, and geology (all determinants of milkweed growth).

From my perspective, I deemed elegance and relevance as critical components of a quality response. However, the PSTs' Monarch Investigation and journal responses revealed a lack of understanding of the components of a quality response. Because they could not discern the requirements of a quality response, the PSTs constructed a standard for themselves: equating the quality of their answer with its quantity of information and/or their effort put into its creation. One PST articulated this approach to completing the investigations: "If you don't know what you have to do to get an A, you are just going to do the best you can and get as much information as possible because you don't know what exactly is needed" (PST 5). Another described her perception that the quantity of information in her answer was indicative of its quality: "I now know the importance of adding extra information … the extra information shows that [we] worked extra hard" (PST 14). Clearly, I had not adequately guided the PSTs to an understanding of what components were needed to construct a quality response to the investigation questions.

Need for Guidance

The PSTs desired more direct explanation of what components they needed to incorporate into their answers to investigation questions:

> I am still confused about what exactly is wrong. I question what exactly you expect out of us with these investigations … We knew we were supposed to research the questions asked, but we had to idea to what extent … We have been handed rubrics describing what the teacher expects of us all through our school years, and tend to have trouble when the guidelines are not set out for us. (PST 9)

Conversely, I wanted the PSTs to gain an understanding of what constituted a quality response over the span of the course. In my journal, I summarized my perspective on how much guidance I should provide to the PSTs when they construct responses to the investigation prompts:

> When I assign investigations, I deliberately choose not to provide a rubric on how the assignment will be graded. Instead, I want to use the iterative attempts as formative assessment of what the PSTs believe constitutes sufficient teacher knowledge. While the PSTs may perceive the first assignment as lacking direction, they quickly receive my feedback on

> ways to improve so that their subsequent attempts can demonstrate growth. When PSTs officially enter the field, they must be able to research the subjects they will be teaching, identify credible sources of information, and find ways to communicate the knowledge in meaningful and appropriate ways. …They need to be able to connect the underlying concepts of the content they teach to other broader areas of science. They are expected to do all of these things without the guidance or structure of a rubric. Indeed, they must have an *internal rubric* to determine the teacher knowledge for each topic they teach. The goal of my class is to help the PSTs develop these skills; providing a rubric to guide them would impede this goal.

Contrary to my perspective on using rubrics, the PSTs felt like a rubric was necessary to adequately complete course assignments: "I think rubrics would be very helpful. It would be easier to try to figure out what you are looking for instead of just trying to guess" (PST 23). PST 13 described the potential structure for such a rubric: "[The rubric] needs to be structured so that we know what to answer … putting a broad question and having a few key points that we must have in the answer is the best idea." I had not provided enough direction for the PSTs, and, instead of feeling supported and empowered to navigate the challenges of developing teacher knowledge on their own, their comments revealed a sense of helplessness.

Response to the Conflict

After evaluating the PSTs' and my responses to the reflection prompts, I recognized areas in which I could improve my practice and purposefully designed several activities to respond to the conflict. In the subsequent class session, I incorporated three activities to address the PSTs' perspectives: descriptive exercise, exploration of rubrics, and identification of course objectives. After these activities, the PSTs completed two more investigation cycles and a final reflection activity before their last investigation: a second attempt at the Monarch Investigation.

Descriptive Exercise

I opened the next class by guiding the PSTs in an exercise to explore the qualities of a sufficient description of a natural phenomenon. I began by stating:

> What we're doing today, we're stalling. We've stopped. We've taken a road trip, a side trip. We have diverted from our path. … it allows us to stop and rethink where we're going. … You need to figure out how to know what we [TE and teaching assistant] want. … And we need to figure out how to communicate to you what we want.

Specifically, I asked the PSTs to describe a golden retriever. After working for several minutes, the PSTs shared their descriptions. I opened a critique of the descriptions by stating: "So, let's think about those answers, and look at yours. I'm not attacking your answer. Don't think that, but I'm wanting to analyze your answer, so

that we can think about what you need to put in future answers." For example, several PSTs shared their descriptions:

PST16: I put, a four-legged mammal. It has eyes, a nose or snout, a tail, paws and mouth.
…
TE: But you're just saying cat. You're right. It could be a large tabby cat, right?
PST12: Yes, you don't usually describe cats as having snouts.
TE: How would you differentiate that from a … fox?

In addition, I modeled the same exercise by sharing my own description of a Boston Terrier. After completing my description, I opened it up for critique from the PSTs. Several of the PSTs made suggestions for clarifying and enhancing my description such as defining terms (e.g., mammal and snout) and providing the origin of the name "Boston Terrier" and the breed's utilitarian purposes. My goals of the descriptive activity were to help PSTs develop an understanding of the appropriate depth and breadth of their investigation responses as well as the ability to evaluate whether their responses met these standards.

Exploration of Rubrics

In response to the PSTs' desire for specific guidelines in the form of a rubric, I asked the PSTs (in groups) to create a rubric for one of the Monarch Investigation prompts: Describe the migration of the monarchs. When I reconvened the class, several of the groups shared their ideas. One group suggested the rubric consist of subquestions that need to be addressed (Why do they migrate? Where do they go? What is the distance travelled? What is the route?). When PST 15 suggested incorporating the number of generations over which the migration occurs, PST 24 responded: "No, we didn't want to be giving the answer." Another group proposed using who, what, when, where, why, and how as a guideline. A third group recommended that the rubric include the key information I expected. PST 17 noted a potential issue with this approach: "But then … I'm just going to do the bare minimum." I mentioned that my investigation prompts had some focus (e.g., *Describe the life cycle of the monarch butterfly* rather than *Teach me about Monarchs*) but were not "too detailed, or I'm squelching the investigation." By creating and discussing potential ideas for rubrics, I guided the PSTs toward an understanding of some of the drawbacks of using a rubric. They interestingly started to think about the components of a quality response without explicit guidelines.

Identification of Course Objectives

I also initiated a discussion about the purpose of the course: "What is the learning objective of this course?" After the PSTs discussed the question in their groups, several PSTs shared their responses:

- For us to learn the information, but to learn how to teach it. … But just not the plain, basic information about something. (PST 13)
- How to provide or how to … [re]search [content] to teach science to the kids. (PST 21)
- I think it's also become familiar with the concepts that you're going to teach to an [elementary student]. (PST 19)

Building upon the last PST's response, I closed the conversation by discussing the importance of identifying the big ideas and concepts when completing their investigation responses and, in the future, when they are a classroom teacher.

Interim Investigations

After the Monarch Investigation, I initiated another that focused on tornados. I asked the PSTs questions regarding how tornados form, where they are most common, and how weather forecasters predict their occurrences. I also assigned a second interim investigation, similar to the Monarch Investigation; I asked the PSTs to describe hibernation in bears as well as the behaviors of other forest animals.

Final Reflection Activity

In the subsequent investigations, I observed improvement in the quality of the PSTs' responses. To further assess the implications of the changes that I made to my practice, I assigned a follow-up reflection journal, which consisted of the following six prompts:

1. What was missing from your report on monarchs that made me think you weren't trying very hard?
2. What was included in your most recent report that made me think you really put effort into your answer?
3. If you had to tell next semester's students what kind of answer I would be looking for, how would you characterize a "good answer"?
4. Do you feel you now know how to earn high grades on your reports? If so, what was the "turning point" for you? If not, what can I do to help?
5. What have you learned from this experience?
6. Is there anything else you would like to share with me at this point in the semester?

Analyzing the PSTs' responses to these journal responses allowed me to gain a better understanding of my role as a teacher educator. I realized that my initial evaluation of the conflict was highly focused on the students and that I was considering their performance on the assignments and engagement with the class as deficient. In other words, I was only attentive to the students' contribution to the conflict. My

perception of the students' performance shifted from criticizing them to recognizing areas in which I needed to better support their development. Specifically, the PSTs' responses to the second set of journal prompts demonstrated the intricacies of student growth (or lack thereof) on two continuums (understanding instructor expectations and developing teacher identities). The PSTs are on various locations along these continuums. Part of my role as a TE is to identify the PSTs' placement on the continuums and help them progress along them. In the case of this self-study, the modification of my practice resulted in student progress, which focused my attention on my responsibility for their development. The first continuum is a critical aspect of my instructional goals for this particular course; the second continuum is applicable to all teacher education courses.

Understanding Instructor Expectations

As described, many of the PSTs did not initially understand my expectations with respect to the investigation assignments and/or the objectives of the course. Although some PSTs still had a *lack of understanding* of my expectations after my instructional interventions, others moved to having an emerging or full understanding. Some of the same misconceptions previously discussed persisted among the PSTs. In particular, some of the PSTs continued to equate quality with quantity. For instance, PST 9 wrote: "I have learned that you have to give more to everything than what is expected." In contrast, others expressed an *emerging understanding* of a quality answer, characterized by perceptive views mixed with lingering misconceptions. For example, one PST wrote:

> What was missing on our 'Monarch Report,' were answers that went beyond the questions. What I think that we finally learned, in our project specifically, was that you answer the question, but you also *add answers to your answer* … We put basic answers, but then defined words that might be difficult for little ones to understand, and we also added in some other interesting facts on top of all that … Instead of just copying and pasting everything off the internet, we actually put thought into each answer and added in information that we each found. (emphasis added) (PST 15)

This PST aptly described aspects of a quality response considering the knowledge relevant for teaching the content; however, she also had a misconception expressed in the idea of adding *interesting facts*. Several of the PSTs demonstrated a *full understanding* of my expectations for the investigations. Unlike the PSTs, who had an emerging understanding, these PSTs did not maintain any previously discussed misconceptions. For instance, one PST described her process:

> I think the most important thing to do when researching a topic is going to as many websites as possible, not just looking at one and getting all of your information from there. Also, read as much as you can about the topic before you write down an answer so that you are writing from your own knowledge about the topic instead of just what it says on the website. For your answers try to think of things to answer (even if they aren't asked in the question) about what kids might ask questions about, this way you are elaborating on your answers. (PST 5)

This PST gave a detailed description of how to search for the information *and* the importance of synthesizing the information. I wanted the PSTs to increase their science content knowledge, view science content from a teacher's perspective, and learn how to acquire, evaluate, and synthesize science content for teaching. My critical feedback on the PSTs' investigations was not sufficient to move them along this continuum of understanding my expectations. Rather, I needed to clearly identify the PSTs' positions on the continuum and implement targeted activities to help the PSTs achieve the course objectives.

Developing Teacher Identities

Understanding the components of a quality response to an investigation prompt is inextricably connected to thinking about content from a teacher's perspective. The purpose of the reflection activities was not only to remediate the PSTs' misconceptions and help them understand my expectations, but also to help the PSTs move from thinking like a student to thinking like a teacher. The PSTs, who persisted in *thinking like a student*, demonstrated many of the same perspectives that emerged after the first reflective journal assignment. For instance, earning a good grade continued to be these PSTs' primary focus. PST 1 wrote: "I feel that I now know how to earn high grades. One reason I know this is because we got a 97 on the last investigation." Not all PSTs had an internal gauge about the aspects of a quality response, but instead relied on external validation from me in the form of their grade. Some of the PSTs moved from thinking like a student to *thinking about teaching*. The PSTs indicated in their responses that they were considering their learning in the course with respect to teaching the content to K-12 students. For instance, PST 22 wrote: "This class has made me really think about how to teach to little kids instead of just having to 'present' in class." The PSTs, who were further along this continuum, were *thinking like a teacher*, considering the daily actions and decisions of teachers. For example, PST 21 wrote: "By spending more time on research and not just answering the question. I acted like I was actually planning on how to teach a science lesson by writing it out." As a TE, I expected the PSTs in this course to take on the role of a teacher (and think from that perspective). I realized that the PSTs remain students during this developmental process and that I must support them in their efforts to simultaneously understand and manage both roles.

Return to the Monarch Investigation

For the final investigation cycle, I reassigned the Monarch Investigation asking the PSTs to prepare a new report that responded to my criticism and feedback on their previous attempt and incorporate what they had learned through the interim activities. On the second Monarch Investigation, I observed more complete and complex

answers to the investigation prompts. One group extensively described the migratory pattern of monarchs:

> Monarch butterflies have a distinct migration pattern that is characteristic only to them [and] takes up to three generations to fully complete. Their spring and summer homes begin to go through a change of season, and become colder and colder … This cold weather eliminates most of their food supply…Therefore, they must migrate south and west to reach warmer weather. Migration, with the first generation of monarchs, begins in Canada and the northernmost parts of the United States in late fall … with a final destination of the Oyamel forests in Central Mexico … Once they reach their roosting site, they cluster in large numbers in the branches and trunks of the Oyamel trees where they remain quiescent, or still with low metabolic rates, until mid-February … By the end of February, after living off their fat reserves all winter, only about half of the original roosting population survives and tens of millions of monarchs begin the spring migration back to their homes in Canada and the northern United States … During their return journey home, the second generation of monarch butterflies roost and reproduce, spawning the third generation of monarchs that will continue the migration into the following fall … Somehow these butterflies will fly back to the same tree in their winter home each year, even when they haven't been there before. (PSTs 10, 11, 17, and 19)

The PSTs' description explained what causes the migration to ensue, the starting point and destination, the Monarch's metabolic state during hibernation, the need for multiple generations to complete the migration, and the unique nature of this migration (as compared to other species migration). Moreover, the PSTs corrected the misconceptions that were present in the first iteration. Another group's description of metamorphosis demonstrated more sophistication:

> When the caterpillar has entered its fifth and final growth stage, many hormonal changes begin to take place … The caterpillar sheds its fifth and final skin at this point. The skin underneath … will actually start off very soft but will harden as the caterpillar hangs. This skin becomes the chrysalis. Inside the chrysalis, the caterpillar will release enzymes that actually digest the tissues of the caterpillar … There are "imaginal disks" inside the caterpillar and these are basically little groups of embryonic cell … Each little imaginal disk will form some body part of the butterfly … Every part of their body is broken down or digested and then rebuilt including the heart, the lungs, and the digestive system … This part of metamorphosis, or change, will last for about 3 to 4 days … The full transformation from caterpillar to butterfly is called holometabolism. (PSTs 5, 12, 22, and 23)

The PSTs' description of metamorphosis in this second attempt provides more depth and breadth to the explanation than was found in their initial responses.

Discussion

A major goal for PSTs as they move into a TEP from their prior StudentWorld and ultimately into the FieldWorld is for them to develop their professional teaching identity (Horn et al., 2008; Quebec Fuentes & Bloom, 2011). Throughout this progression, PSTs are provided many opportunities to experiment with provisional selves through approximations of practice (Grossman et al., 2009; Ibarra, 1999). As PSTs take on the role of teacher and achieve various levels of success and failure,

they will quite naturally encounter various frustrations (e.g., Ma & Singer-Gabella, 2011; Smagorinsky et al., 2004). A key responsibility of a TE in this context is to support the PSTs through their frustration so as to prevent them from shutting down and, thus, ending the learning process as well as stifling the development of their teacher identity (Daloz, 1999; Horn et al., 2008; Kegan, 1994). In order to effectively accomplish this critical task, the TE must be able to take time to reframe the problem, and ultimately provide learning experiences to empower the PSTs to navigate through and learn from their frustrations. Self-study provides one window through which a TE can examine his practice to determine how effectively he is scaffolding the learning of PSTs (Samaras, 2011). With insight gained from self-study, a TE can modify his practice and incorporate new learning activities to help the PSTs develop.

In the context of the present study, the PSTs experienced frustrations as they transitioned from the StudentWorld to the TEPworld. The course described herein was early in the TEP and one of the first opportunities the PSTs had to experiment with provisional selves. Some of the challenges they experienced stemmed from the fact that the PSTs' provisional selves were informed by what they had seen and internalized about teaching during their K-12 learning experiences (Lortie, 1975; Quebec Fuentes & Bloom, 2011). Further, this was the first time the PSTs had to assume dual identities: that of student in the TEP course as well as future teacher. These challenges became evident in the context of the content investigation and presentation regarding monarch butterflies.

The conflict demonstrated that some aspects of my practice were not working as I intended. I decided to stop the course progression, rethink my initial perceptions regarding the PSTs' performance, and instead take time to identify the problem (Cuban, 2001) and turn the conflict into an educational opportunity. I chose to use reflection activities to accomplish this goal (Moon, 1999). Through the PSTs' initial journal responses and my reflections on them, I was able to identify the source of the conflict and the resulting tensions for my practice. The conflict was grounded in the fact that I was assuming the PSTs were operating from a TEPworld perspective while they were, in actuality, still approaching the course from the StudentWorld perspective. Through the conflict, I realized three tensions in my practice: telling and growth, safety and challenge, and confidence and uncertainty (Berry, 2007a, 2007b).

The telling and growth tension was evident in my struggle between (a) telling the PSTs what they needed to know in order to compose a quality investigation report and (b) wanting them to take my feedback and struggle to grow in their ability to self-assess the quality of their work. Being unwilling to provide clear instructions (e.g., rubrics) for the PSTs to follow led to a second tension: safety and challenge.

Because of my lofty goal for the course (to begin to move PSTs from the StudentWorld to the TEPworld) and the lack of clear direction on the major course assignments, the course was, by its own nature, quite challenging for the PSTs. My tension regarding safety and challenge centered on balancing the challenging nature of the course with a safe and productive educational environment that would support the PSTs in their teacher identity development. The Monarch Investigation

served as a critical juncture in the course. The PSTs were frustrated and expressed feelings of being unsafe. This turning point allowed me to address the PSTs' concerns and work through this tension of safety and challenge to reassure the PSTs of the safe environment in which they were learning while persisting in my plans to challenge their growth. Dealing with the tension at this point in the course prevented the PSTs from shutting down and thus maintained their progression into the TEPworld.

The course activities and the approach that I took to encourage the PSTs to develop toward their teacher identity, by their own design created a challenging environment in which the PSTs felt discomfort. Taking this approach, and persisting with it in light of the two aforementioned tensions that it created, led to a third tension for my practice: confidence and uncertainty. I understood if I did not adequately support the PSTs through this uncomfortable learning experience, they could halt their learning and/or lose confidence in me. This created a sense of uncertainty for me. My tension focused on maintaining a confident demeanor while dealing with this uncertainty. Acknowledging the frustrations of the PSTs with respect to my practice in a public and transparent manner exposed this tension and simultaneously shared my vulnerability while maintaining the PSTs' confidence in my leadership.

To mediate the tensions, I used multiple means of reflection. Some of the reflection activities occurred individually while some occurred in collaboration with the PSTs and me. The PSTs reflected individually through writing responses to journal prompts that I provided. I reflected, via personal journal entries, on my teaching practices. Collaborative reflection occurred during class sessions when the PSTs and I openly shared and discussed our distinct perspectives. These reflection activities served several purposes (Moon, 1999). Initially, the reflection activities served to identify the sources of the conflict as well as the existing tensions for my practice. The PSTs' and my emotional responses needed to be rationalized. Journaling and subsequent class discussion allowed me to move beyond my initial interpretation of the event, namely that the PSTs were not putting forth much effort. The PSTs also recognized my intentions as less critical and more constructive. Further, the PSTs and I gained multiple perspectives on the conflict and better understood each other's positions.

Reflection was also used to address the identified problem for which there was no obvious solution. Using reflection, I was able to consider my practice in real-time, identify tensions in my practice, and modify my practice while still meeting the course objectives. Additionally, the modifications I made involved using reflection as a pedagogical tool. By giving the PSTs a voice in the learning process, I guided students in their professional identity development, developed a culture of trust and respect, and modeled a pedagogy of reflection.

In the final journal response, many of the PSTs' entries indicated a shift in their understanding of the course objectives and their role in the course. With respect to the investigations, the PSTs aligned with different positions on a spectrum of understanding the components of a quality response, ranging from harboring misconceptions to an emerging understanding to a full understanding. Similarly, on an identity spectrum, the PSTs ranged from thinking like a student to thinking about

teaching to thinking like a teacher, a spectrum that parallels the framework by Sutherland, Howard, and Markauskaite (2010). These findings demonstrate that my approach of using reflection as a pedagogical tool was effective. I also realized my important role in the professional identity development of PSTs as well as the fact that the rate of growth among PSTs varies.

In addition to helping the PSTs grow in their identity development, I identified two more positive outcomes resulting from this self-study. As previously described, there was a significant conflict between the PSTs and me following the Monarch Investigation presentation. Through the reflection journals and class dialogues, I re-established and repaired the class culture. One PST described what she learned with respect to the classroom environment that I created through the reflection activities:

> I have also learned that the atmosphere of the class is very important and students have to feel comfortable enough to speak up when things are not going the way they think they should or they are confused about something. (PST 7)

The PSTs appreciated my flexibility by addressing the conflict and considering their points of view: "[I]t is nice to see a professor changing style and evaluating as the semester goes along and actually take students input into consideration" (PST 6). PST 17 acknowledged the importance of communication with me via the class discussions and journal prompts: "It is great to create a relationship with a professor where communication and compromise can occur on an everyday basis." I opened the lines of communication with the PSTs and provided them with the opportunity to share their perspectives through the reflection activities, thereby establishing a culture of respect and trust. This process allowed me to manage the tension between *safety and challenge* without compromising the challenging and somewhat unfamiliar nature of the course.

The PSTs not only appreciated my efforts to understand their views, they also realized the importance of listening to and communicating with their future students, especially when conflict arises. PST 1 wrote:

> I just wanted to say that at first I was sort of confused by the fact that we were taking away class time to discuss the investigation problem, but now it completely makes sense. I know this class is called "Science for Elementary Teachers" and so I was solely focusing on the fact that we weren't learning as much science, minus the investigations for the past two weeks. I now realize that this is also about being teachers in general. It has been an awesome experience because you have been a perfect example of how a professor/teacher should act if this situation or problem were to arise in one of our classrooms one day. So, thank you!!

Through the process of self-study, I modeled how to navigate conflict using reflection activities. Similarly, other PSTs connected their experiences in the course with her future practice:

> I have learned that as a teacher you really have to meet your students where they are and talk with them to see where there was miscommunication when problems arise. This class has made me realize the importance of discussing things in class and I have really enjoyed that aspect of class. (PST 7)

My use of reflection activities led to this unexpected outcome; that is, the PSTs also learned about the pedagogy of reflection: "I have really benefitted from seeing a class that is not so structured that the schedule becomes more important than learning. I think that is a very important lesson to learn before becoming a teacher" (PST 12). Similarly, PST 20 commented:

> I learned that it is critical to be open and honest with your teacher (or students) if you aren't receiving the results you want from each other. I know that sometimes it might be awkward and not easy, but the end result will be worth it. Communication is everything!

By adjusting my practice via the self-study process, the PSTs learned about gaining knowledge for teaching as well as the importance of reflection to support meeting course objectives.

Conclusion

Self-study allows educators to evaluate their practice, identify what is working and what needs improvement, and modify their pedagogical approach (sometimes in real time) to deal with problems, challenges, or tensions. Self-study is particularly important for TEs, as transitioning from a student into a teacher is a challenging process for PSTs, one which TEs must support. One reason this process is so challenging is that PSTs have dual roles of student and developing teacher. While PSTs will always have these dual roles, as they move along the continuum from student to teacher, they increasingly engage in their TEP coursework from the perspective of a teacher. The TE's role is to help move the PSTs along this progression, from thinking like a student to thinking like a teacher, while recognizing that the PSTs will often reflect myriad points along the continuum.

Enacting this role, however, can create tensions in the TE's practice as the PSTs experience this transition. The TE's tensions may reveal themselves in the form of conflict between the TE and the PSTs. Through self-study, the TE is able to address and investigate the conflict as well as the underlying tensions in his practice that the conflict reveals. One approach to accomplish this goal is the use of reflection activities to investigate (gather information about) and address (guide PSTs' learning through) such situations. In this way, reflection is used as both a research and pedagogical tool. The primary purposes of the reflection activities are to reframe the problem and allow the TE and PSTs to understand each other's perspectives. By collaboratively accomplishing these goals, the TE can modify instruction to address the conflict in a meaningful and productive way. In addition to the primary gains of employing reflection activities, secondary outcomes may also result. By giving voice to both the TE and the PSTs via reflective dialogue, a culture of respect and trust is fostered. In such an environment, PSTs more willingly share their challenges and struggles, thus allowing the TE to better understand PST needs (and thus meet them). Further, employing self-study in this manner models the pedagogy of reflection for the PSTs. The PSTs recognize the value in halting instruction to deal with

challenges and employing this form of inquiry as they move into the complex profession of teaching. As such, the present research demonstrates the potential contribution of self-study to the pedagogy of science teacher education as well as K-12 instruction.

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