Becoming Aware of the Challenges of Helping Students Learn:
An Examination of the Nature of Learning during a Service-Learning Experience

By Molly N. Lawrence & Malcolm B. Butler

Introduction

Learning to teach is an incredibly complex endeavor with nuances that elude even those carefully observing it. "Even when observing good teaching or experiencing it for oneself, one cannot easily glean a deep understanding of the complexity of the work" (Hammerness, Darling-Hammond, Bransford, & others, 2005, p. 368). Fresh out of their own experiences as K-12 learners, candidates possess a variety of conceptions of schooling, learning, and teaching based on their "apprenticeship of observation" (Lortie, 1975). Although many experiences provide a rich framework on which to build their learning throughout teacher education, preservice teachers' interpretation of what they observed in the classroom often leads to the formation of preconceptions of schooling that are difficult to overcome during a teacher education program (Hammerness, et al., 2005). These include beliefs that teaching is easy (Britzman, 2003), that concepts and ideas in teacher preparation programs are familiar and

Molly N. Lawrence is an assistant professor of secondary education in the Woodring College of Education at Western Washington University, Bellingham, Washington. Malcolm B. Butler is an associate professor of science education in the College of Education at the University of South Florida, St. Petersburg, Florida.

obvious, and that learning is a simple and mechanistic process that entails little more than a one-way transfer of information from teacher to student. As a result of such preconceptions, many preservice teachers tend to envision teaching as telling and have a difficult time comprehending the challenges students face while learning in their classrooms.

Constructive views of knowing elucidate learning as humans' attempt to interpret the world based on their extant knowledge, skills, and developmental levels, which influences what students ultimately learn (Bransford, Derry, Berliner, & Hammerness, 2005). As such, scholars have begun emphasizing the importance of addressing preservice teachers' preconceptions during preparation programs to offer them space to change the beliefs they held prior to entering the classroom (Bransford, et al., 2005; National Research Council, 2000).Without engaging their preconceptions, preservice teachers may fail to understand new conceptions or learn ideas to perform well on a test but revert to their initial ideas once outside the classroom (Hammerness, et al., 2005). The 'teaching-as-transmission' preconception is particularly difficult for teacher educators seeking to prepare novices to use pedagogies that are compatible with current research on how people learn (National Research Council, 2000). Asking novices to move beyond this pedagogical metaphor often requires them to make a fundamental shift from the approaches they participated in as learners (Hammerness, et al., 2005). Thus, designing learning experiences that allow preservice teachers the opportunity to reconsider the use of more traditional instructional approaches, and to assess their benefits and shortcomings, is often a challenge. Short-term interventions intended to accomplish these ends have typically resulted in few changes to novices' preconceptions (Hammerness, et al., 2005; Wideen, Mayer-Smith, & Moon, 1998).

Even more difficult than changing preservice teachers' preconceptions of learning and teaching is helping them learn to teach in ways that align with how people learn (Hammerness, et al., 2005). Various scholars have noted disparities between what preservice teachers desire to be as teachers, what they know about teaching upon leaving their program, what they say they will do in the classroom, and their actual teaching practices upon entering the profession (Crawford, 2007; McGinnis, Parker, & Graeber, 2004; Windschitl, 2003). Furthermore, it is not uncommon for novices to think of their teaching as distinct from rather than in constant relation to the learner, focusing initially on their own teaching practices while paying little attention to student learning until they have been in the field for an extended period of time (Kagan, 1992; Nuthall, 2004; Wilson, Floden, & Ferinni-Mundy, 2001). Scholars have attributed this to novices' developmental stage, or "klutziness" (Bransford, et al., 2005), which contributes to their inability to attend to many factors at any one time. How can teacher educators design learning opportunities that disrupt such preconceptions of teaching and encourage preservice teachers to wrestle with the complexities of facilitating learning that result in improved ability to enact oneself as a teacher effectively earlier in one's profession?

In response to this question, it has been suggested that great care be taken in designing learning experiences intended to support preservice teachers' effective actions upon entering the classroom. Scholars have suggested that quality learning experiences should: (1) include "direct and ample" opportunities for preservice teachers to interact with students (Bullough, Knowles, & Crow, 1992); (2) integrate fieldwork and university coursework in order to connect and allow preservice teachers to better negotiate theory and practice (Darling-Hammond, Hammerness, & others, 2005; Feiman-Nemser, 2001); and (3) provide opportunities to engage in structured reflective tasks where cognitive dissonance can be articulated in a supportive environment (Jones & Vesilind, 1996; Kagan, 1992).

These findings recently became relevant to our work with a group of preservice middle grades science teachers who participated in a service-learning experience at a local elementary school as a portion of their middle grades science methods course. The purpose of this manuscript, then, is twofold: First, we explore the nature of the learning in which our students engaged during this early service-learning experience in efforts to understand the meanings of teaching and learning they constructed, and how the context of this experience interacted with our candidates' previously constructed meanings of teaching and learning. Because our candidates had previously engaged in a more traditional early field experience, we also wondered how this service-learning experience would contribute differently to their learning than previous experiences had. Second, this manuscript is intended to provide a description of the service-learning field experience in which our candidates engaged so that others can consider ways to construct similar experiences for their own candidates in collaboration with schools and K-12 personnel. We believe the nature of a service-learning focus (Cone & Harris, 2003; Pickeral, 2003) is a particularly empowering model for conceptualizing field experiences in teacher education and briefly define this term as well as our rationale for this argument in an upcoming section. Thus, although our primary focus is the meaning making in which our candidates engaged, and the connection between the context of this experience and these deeper meanings of teaching and learning, we include relevant details of the service-learning experience throughout our work in an effort to continue pushing ourselves and others to find ways to address the learning needs of preservice teachers while doing so in a way that align service-learning approaches.

An Overview of Participants

The participants in this study were candidates in a middle grades teaching certification program at a large university in the southeastern United States. Approximately half of the candidates' primary area of content specialization was science. All seventeen of the individuals in the class were asked to participate in this study and twelve consented. Ten of the twelve participants were females. Additionally, one of the participants was Hispanic, one was a member of the military,

and one was a former engineer who was returning to school after staying home with her children. All of the preservice teachers were planning to student teach the following year and had completed one six-week field experience the previous semester. During this prior field experience, all of the participants were in charge of teaching for at least two days in a middle grades classroom. Beyond this requirement, preservice teacher responsibilities varied during this placement: some taught every day, while others worked alone creating a model of the solar system for students, per the request of the cooperating teacher. In addition, some of the participants were in science classrooms for this placement and others worked in non-science classrooms.

Defining Service-Learning and Describing the Service-Learning Experience

Previously, we mentioned the power in conceptualizing field experiences in teacher education as service-learning experiences. Here we define service-learning, provide a rationale for this statement, and describe the service-learning experience in which our candidates participated. In this study, we define service-learning as a process of integrating action and intention, as practical experiences that are reciprocally beneficial for all involved, and as a teaching method in which academic instruction is combined with community service while focusing on reflection and critical thinking (Campus Compact, 2003). It is also important to note in order for a field experience to be considered service-learning it must be designed in ways that are responsive to the needs of the community.

Often, the nature of service-learning experiences diverge from more traditional field experiences as traditional placements tend to be arranged based on the needs of university personnel rather than in response to the needs of schools, teachers, or students in our communities. With this definition in mind, the potential power of service-learning becomes transparent: (1) these learning experiences can benefit all parties involved, rather than aligning only with the needs of our teacher candidates, making it more likely for long term relationships and collaborations to develop; (2) they have the potential to result in authentic collaboration with diverse stakeholders, which requires engaging in dialogue, negotiating divergent perspectives and priorities, and consistent focus on the tensions and complexities experienced in the peopled world of the teaching profession (Boyle-Baise, 2002); and (3) they help schools and universities to accomplish more than they could alone, resulting in higher quality learning for all involved. Studies on service-learning indicate these proposed benefits are real possibilities (Eyler, Giles, Stenson, & Gray, 2003).

In addition, scholars have found that service-learning experiences often positively impact participants' understanding of the complexities of the field and their abilities to problem-solve and think critically while resulting in instructors' satisfaction with the quality of learning that transpired (Eyler, et al., 2003). More importantly,

service-learning experiences have been identified as ways to help candidates make personal connections with people unlike themselves and to connect with disenfranchised communities, both of which align with the goals of multicultural teacher education (Boyle-Baise, 2002). For these and a variety of other reasons, we believe service-learning provides a powerful lens for conceptualizing field experiences in teacher education. Throughout this work, then, we explore the service-learning nature of the field experience in which our candidates participated.

The service-learning experience in which our students participated occurred during a middle grades science methods course taught by the first and second authors. The second author had previously collaborated with teachers at a local elementary school and developed rapport with both the principal and the science teacher of gifted and talented students. When he heard of the school's need for volunteers to work with fourth grade students in planning a Family Science Night, he agreed, believing the opportunity would mutually benefit the students and teachers at the school, the surrounding community, as well as our teacher candidates.

We decided this service-learning experience should be an integral component of our candidates' science methods course, believing it would be highly beneficial to their learning. As such, we took time out of class to meet at the local elementary school (Blackfoot Elementary School, hereafter referred to as BES) where our preservice teacher candidates worked with a fourth grade student partner. Thoughout the semester, we met at BES seven times. These meetings occurred approximately once every week or two, starting about a month into the semester, and ending a few weeks prior to the end of the semester.

In addition, we continued to hold class sessions at the university in between our meetings at BES; portions of our course were spent discussing the experiences and concerns preservice teachers had regarding their work at BES. Both authors communicated with the elementary teacher in charge of organizing the Family Science Night on a regular basis in order to better understand her goals for students and community members who would ultimately attend, while sharing our own needs as instructors of the science methods course. Typically this communication happened via e-mail or in brief meetings prior to or following our whole class meetings at BES.

During the meetings at BES, each of the preservice teachers was paired with one fourth grade student. Preservice teachers worked with this student during each of the hour-long sessions at BES to help their partner understand the science concepts and key ideas at the heart of a particular science activity. Ultimately, the fourth grade students needed to understand the science concepts associated with their activity because they would be in charge of facilitating the learning of other students and adults at a Family Science Night activity booth. In addition to teaching these science concepts and ideas to their fourth grade students, preservice teachers were also responsible for helping their fourth graders create a display board for the activity booth and for learning to speak publicly about their science activity and content.

Additionally, the preservice teachers attended Family Science Night and helped

their fourth grade partners lead parents and students through the science activity and teach them the science behind the activity. Although it was our intention that the fourth grade students teach parents and students who stopped by their activity booth, the degree to which this happened varied considerably. Some fourth graders were unable to attend the Family Science Night; others were very excited to participate in other booths and activities at Family Science Night and left their booth frequently. Thus, many of the preservice teachers ended up being in charge of the activity booth for part or all of the Family Science Night.

During work sessions at BES, the first and second authors as well as the elementary school teacher allowed the preservice teachers considerable latitude and space in working with their student partner. We did not intervene in preservice teachers' work with their student partner unless help was specifically sought. When preservice teachers were having difficulties teaching, they often came to us for help after their interaction with their students. We provided suggestions, feedback, resources, and clarification of science content when requested. Furthermore, we worked with fourth grade students when preservice teachers were absent. Thus, we were intimately involved in the experience and invested in preservice teachers' learning.

The science activities used during Family Science Night were selected by Dr. Friar (pseudonym), the elementary school teacher in charge of facilitating the event. Dr. Friar was a science specialist with her Ph.D. in Science Education who had taught science to students who were identified as gifted for over 20 years. She suggested a variety of activities that she had used previously and successfully with this age group of students as possible activities for Family Science Night. She also provided the majority of materials required for these activities and a brief description of the activity for our candidates. In addition to an interest in selecting activities that were developmentally appropriate, Dr. Friar also selected activities that were intended to quickly captivate passerbys at the event.

Although most of the activities contained a brief description of what to do, the majority of preservice teachers found this information insufficient and ended up searching for additional information to deepen their conceptual understanding while refining and redefining the science concepts and ideas to be addressed within this activity by utilizing current state standards for K-5 science. In addition, the first and second authors and Dr. Friar collaborated with candidates extensively throughout this process working to ensure developmentally-appropriate learning objectives for the fourth grade students. However, due to the dual focus of our candidates' learning to plan for developmentally-appropriate instruction and the need to engage others who would ultimately attend the Family Science Night, we found planning for developmentally-appropriate instrution more challenging than if teaching content aligned with the state and national standards had been our primary focus. Some of the activities that were selected to be highly engaging were based on complicated scientific phenomena, which provided candidates with a significant challenge in finding ways to teach the concepts in intellectually honest (Bruner, 1960) ways.

Data Collection and Analysis

Our data collection and analysis were shaped by qualitative research traditions (Charmaz, 2006; Denzin & Lincoln, 1994). Various types of data were collected throughout the service-learning experience including four key categories. First, written responses to questions about science teaching and learning at the outset of the university course. Although only a few excerpts from these initial written responses are incorporated into the analysis section, we were able to compare these responses to what participants shared during the interviews and focus group allowing us to note those newly constructed meanings of teaching and learning that were most significant in light of how our participants were initially thinking about teaching and learning.

Second, weekly written reflections after meeting with fourth grade student partners (modified from Cook & Young, 2004). On this form, our preservice teachers described successful and less successful aspects of their interactions with their student partner, identified what their student partners required of them and which of these needs were expected and unexpected, how they responded to these needs, what barriers they encountered as they tried to respond to these needs, and how they would have to grow or change in order to respond to these needs more successfully in the future.

Third, 20-40 minutes semi-structured interviews (Patton, 2002) were conducted after the initial group of meetings with their student partners. Our protocol was based on the experiences, ideas, and concerns described by participants on their weekly reflection forms.

Fourth, a focus group interview (Kleiber, 2004) was conducted after the Family Science Night during which we asked participants questions about the impact of this experience on their professional development. Our questioning focused specifically on the ways in which this experience resulted in candidates refining their initial ideas, reconsidering meanings of teaching and learning constructed in previous field experiences, and developing new and unexpected understandings of teaching and learning. The interviews and focus group were audiotaped and the data transcribed verbatim.

Due to various constraints, the amount of data collected varies from one participant to the next. Some participants did not attend the focus group; others' interviews were not recorded due to technical difficulties; and some participants turned in one less weekly reflection than others. However, all participants completed at least three of the four data collection activities and most completed all four.

Because the primary focus of this manuscript is to explore the meanings of teaching and learning constructed by our candidates, we did not formally collect data regarding responses of the fourth grade student partners, Dr. Friar, or the community members who attended the Family Science Night. We also did not conduct

a detailed analysis of informal data collected that speaks to stakeholders' response; although we have evidence to indicate that this service-learning experience was beneficial to the fourth graders, Dr. Friar, and families from the community attending the event.

Data regarding the meaning making of our participants were analyzed inductively (LeCompte & Preissle, 1993). That is, initially we identified the specific meanings preservice teachers were constructing about science teaching and learning as a result of their participation in this experience; then we grouped these meanings into categories using HyperResearch—a qualitative data analysis software package—and looked for relationships among meaning categories. Although evidence indicated that the preservice teachers had constructed significant meaning during this experience, we were unsure how or if these meanings were connected. Many seemed discrete from each other. However, upon further reflection on our data analysis we came to see four of the meaning categories as highly interconnected. These four are the only categories emphasized in this manuscript. They include:

- Ensuring that K-12 students understand what was taught takes considerable time and effort.
- Ascertaining students' prior knowledge is a prerequisite for teaching effectively.
- Balancing science content with students' cognitive abilities is a complex process.
- Making learning relevant benefits student learning in various ways.

Finally we looked for explicit and implicit links between these meaning categories and the context as well as ways in which these meanings differed from those we had observed being constructed in previous field experiences.

Findings

As preservice teachers engaged in this service-learning experience, the subjects of our study were primarily focused on attempting to teach for understanding. However, they came to realize how difficult teaching for understanding was and began to realize it was impossible to separate effective teaching from knowledge of and ability to respond to the needs of their students. Thus, candidates represented their learning about teaching as something that existed in dialogic tension with the learner. In our data, the preservice teachers' talk distinguished them from the general trend in the literature which indicates that preservice teachers tend to "focus on and describe their own actions as teachers rather than the actions of pupils" (Kagan, 1992, p. 133) and have only "vague ideas about the nature of pupils" (Kagan, p. 141). Unlike many of the preservice teachers with whom we previously worked, they portrayed teaching as something that requires complex knowledge of their

students. Thus, we will initially describe the meanings of teaching and learning constructed by these preservice teachers and then explore the relationship between these meanings and the contextual factors of this service-learning experience.

Meanings of Teaching and Learning Constructed by Preservice Teachers

Ensuring that students understand takes considerable time and effort. Many of the preservice teachers expressed their surprise that effective science teaching took more time than they had originally thought prior to this one-on-one interaction with their fourth grade students. Participants not only emphasized that it was necessary to employ multiple approaches when teaching, but also that it was surprisingly difficult to actually make sure students were understanding the science concepts. The following statements taken from interviews and focus group conversations exemplify this category of meaning.

Focus Group Discussion:

Interviewer: How have your ideas about science teaching changed throughout your interactions with your student partner?

Kary: I guess how many different approaches you're going to have to try before they're going to get it. I never thought you'd have time to explain things three different ways and since I usually always got things the first or second try, it was strange to see how many times I had to explain something for her to finally get it.

Brittan: I agree. It took me several different ways to try to teach it to her…she finally understood it, but it took several different ways. I didn't expect it to take that long. I thought she'd get it the first day.

Interview with Carolina:

Carolina: It was really hard to explain it to her. That has been the biggest challenge: explaining it to her and being sure that she understood what I said. It took me a LONG time to explain her.

Interview with Tammy:

Tammy: For me, gosh it's so challenging. Yesterday my student and I clashed because he wasn't understanding the concept of molecules and I was trying to think of different examples to tell him the difference between a solid, liquid, and gas and use examples. It was hard for him. I finally had to say, let's move on and we'll go back to it. He got stuck and I didn't know what else to do, 'Oh Lord!'

Later in the interview with Tammy*:*

Interviewer: Based on your interactions with your student and planning this Family Science Night activity, has there been anything that's really surprised you as a future teacher?

Tammy: Yesterday when I was just so frustrated…not being able to help him with understanding the molecule concept. I started thinking about teachers and how

> so many kids are overlooked because I think they get so frustrated when the kids don't understand something that to save them the grief they just move on. I think that's going to be my biggest challenge—trying to get to all the different kids.
>
> *Interviewer*: It's interesting because when you came in you talked about wanting to meet the needs of every learner, but it's interesting that this helped you realize...
>
> *Tammy*: (jumping in) Yeah—it's easier said than done. Definitely.

Although these preservice teachers had already taught middle grades students prior to this one-on-one, content-focused experience, they were still surprised that science teaching took such a long time, required a number of approaches, and was so difficult in general. They noticed themselves running out of instructional approaches to help students understand science concepts. They found themselves frustrated and wanting to move on when students did not understand concepts because this was easier than continuing to feel frustrated engaging in the process of helping students understand. Furthermore, they made connections between their individualized work and their future classrooms, realizing how difficult it must be to help an entire class of students learn in light of the challenges of supporting just one student's learning.

Ascertaining students' prior knowledge is a prerequisite for teaching effectively Throughout their interactions with fourth grade students, participants began emphasizing their need to gain a better sense of what students already knew and what students were capable of doing. Furthermore, participants described how they tried to learn about their students' capabilities.

Interview with April:

> *April*: The part that I was having trouble with was figuring out what level to approach teaching fourth grade at. Just being familiar with what they're supposed to know already, what information they're coming in with, and how to approach it...it was hard to figure out where she was coming from so I could build from there.

Later in the interview this same concern resurfaces:

> *April*: Her content level knowledge is the part that I was surprised that I was unprepared to...I just hadn't thought about it.
>
> *Interviewer*: What do you mean "her content level knowledge?"
>
> *April*: What science concepts does she understand? Does she know what energy is? Does she understand how energy can be stored and used and preserved? To me those are abstract concepts, so I was not really expecting her to get it. I was hoping that she had covered it in a science class, but I think that's something that happens later on. And I'm sitting here looking at this adorable fourth grader thinking, "I don't know how to explain this to you."

Interview with Tammy:

Tammy: It's scary right now, because I'm a little nervous about how to go about teaching harder concepts to fourth or fifth graders.

Interviewer: Is this something that you realized would be such a big difficulty when you started this interaction?

Tammy: NO! I didn't...

Interviewer: What were you expecting it would be like?

Tammy: I didn't really know what to expect. But I haven't worked with a lot of students in general so I didn't know what their ability level was or how they go about understanding science, and I don't know how the kids understand science at that level.

Interview with Fred:

Fred: I have to be a little bit more careful with language and vocabulary. Because I'll start throwing out terms and she'll just give me that look. And I'll be like, "Ok, well you know when you drag your feet across the carpet." If I can keep it in that sense, she'll get it. But I just went off on the physics of static electricity she's said, "Go back a little." Not knowing exactly what she knows I have to be very careful that I don't have a preconceived notion of what she should or does know.

Interview with Carolina:

Carolina: I have a really hard time getting to that point to where I'm really good at explaining, but once I figure out a way to explain something I can do it.

Interviewer: What does it take for you to get to the point where you explain it really well?

Carolina: Understand the level that she's thinking at,—how much she understands the concept and if she understands more of the concept then I don't have to simplify it as much.

These preservice teachers clearly link their ability to successfully teach students with their ability to understand what individual students know prior to instruction. They emphasize the need to gauge students' understanding during instruction in order to know how to proceed with their work. It is also interesting to note that three of the four preservice teachers highlighted the importance of knowing what their individual student understands, rather than speaking about what students, in general, understand.

Balancing science content with student cognitive abilities is a complex process. In addition to linking an understanding of students' prior knowledge with effective teaching, the preservice teachers also began grappling with the notion of how much science their students needed to understand and how much science their students were capable of understanding. Despite their work with state standards for K-5 science

learning, their conceptions of what students were capable of understanding were consistently challenged and refined throughout this service-learning experience. They wondered whether teachers should always expect students to understand the entire science concept.

Focus Group Discussion:

> *Carolina*: For me the most difficult thing was to simplify. Some concepts were long and difficult and it was really hard for me to simplify it.
>
> *Kary*: Yeah. It seems the more you simplify, the less science you kept with it. I felt like I kept taking away from it [the science concept] every time I tried to say it more simply. I kept thinking, 'How much of this does she really need to understand? Am I getting that across to her?'
>
> *Mary*: I completely agree. You want to expose them to as much science as you can because they need to understand what's going on. I don't think she needed to understand everything about science that was going on in your activity.

Interview with Joy:

> *Joy*: I was surprised how difficult it really was to, it's not dumbing down the science, but to make it a simple concept. And how difficult it really is to keep the science in the explanation. I kept researching 'for kids' and it would either be too basic or something that we would understand. I struggle with that.

Interview with Tammy:

> *Tammy*: I think it's going to be a challenge for them to understand the concept without getting into too much detail.

Interview with Fred:

> *Fred*: We're still not up to why the Van der Graaf generator raises hair or anything like that, which is mentally what I wanted. I thought my day would have been a success if I could leave with her understanding that.

Preservice teachers began realizing that the seemingly objective knowledge they were supposed to teach students involved many more decisions than originally envisioned. Their ideas about knowledge became more complex as they suggested that science concepts are not something a teacher can just look up and teach to students. Instead, these ideas required thinking about how much information their students were capable of understanding and needed to understand, which required the preservice teachers to know their students as well as their subject matter well. At the same time, candidates found that in trying to balance accuracy with students' conceptual capabilities, it was difficult to strike an appropriate balance between two seemingly conflicting perspectives: Either the information was oversimplified, sacrificing accuracy, or the student was confused because the concept was too advanced, sacrificing the learner. Thus, the preservice teachers began to realize the complexity of scientific knowledge and began trying to balance this with students' cognitive abilities.

Making learning relevant benefits students in various ways. Participants also discussed specific examples from their interactions with their students that helped them realize the importance of linking content to students' lives and interests. Although some of the participants mentioned the importance of making learning relevant in their written responses completed prior to this experience, their comments clarify the increased significance of this kind of thinking after working with their student partners.

Interview with Fred:

> *Fred:* The one thing I've learned with Briana is I've got to tie into her experiences as much as possible, which has been a challenge for me because one of the huge things in her life is dancing, which I have very little experience with personally. I'm trying to learn about it by asking things like, 'Ok, what do you dance on? Is it a floor? Is it a mat?' So I can tie into that. But I've found this to be one of my biggest things.

Focus Group Discussion:

> *Joy:* When I brought in prior experiences, my student actually taught me a lot. Once he saw one connection, he just started thinking of more and more examples. That definitely showed me how important prior experience and relating it to their world really is.
>
> *April*: When I was talking to my student about potential and kinetic energy she didn't really get it until I pulled in her passion, which was basketball, into it. I explained to her that a basketball in this position has potential energy and when she's throwing it it's got kinetic energy. Then she got it. I think that it's really important to tie learning into students' individual lives as much as possible.

Candidates emphasized the importance of making learning relevant by referencing specific instances during their interaction with their fourth grade students. Not only did the preservice teachers conclude that linking learning to students' prior experiences increases student understanding, they also talked about the challenges they, as teachers, faced in trying to make learning relevant. As Fred explained, it is difficult to make such connections if you do not know much about that particular child's prior experiences. In addition, Joy pointed out that making learning relevant allows students to get involved in learning, as her student did when he started listing prior experiences that demonstrated the principle underlying their activity.

Constructed Meanings and a One-On-One, Content-Focused Context for Learning to Teach

In considering the meanings of teaching and learning these preservice teachers constructed while interacting with their fourth grade students, we were struck by the emphasis they placed on the need for dialogic tension between student and teacher in effective teaching. In our previous work with preservice teachers, we generally found their primary focus to be on what *they* were doing. Many studies support this trend (Britzman, 2003; Kagan, 1992; Nuthall, 2004; Wilson, et al.,

2001). However, this was not the case with their constructed meanings of teaching and learning during this experience. These beginning teachers concentrated on how well students were learning and how their teaching was linked to student learning.

Rather than talking about teaching as something they do and learning as something students do, and drawing few links between the two, these preservice teachers presented a highly integrated, contextualized picture of teaching and learning. They spoke of the amount of time it took to teach their students so that they truly understood the content, their inability to teach students without knowing what their students knew about the content, the need to balance the content they were teaching with students' cognitive abilities, and the importance of teaching in a way that made science relevant to students' lives. Participants clearly made significant strides in challenging the preconceptions they brought with them into the program, many of which had gone unchallenged in previous, more traditional field experiences. Although at the outset many emphasized a desire to help all students learn and be successful, this goal was mediated by the perspective that teaching was fairly simple and that the teacher's primary role was to know the subject matter and be able to explain it well to students.

Even those who emphasized that it was important for students to be more actively engaged in their learning quickly fell back on practices more like their own school experiences in their initial interactions with students. However, these preconceptions, incomplete understandings, and behavioral tendencies were disrupted in their repeated work with one student throughout the semester. Those realizations they found most surprising during this field experience often paralleled those they emphasized as important in responding to reflective prompts at the beginning of the semester. However, they clearly lacked a deep and nuanced awareness or understanding of how influential these seeming truisms were in facilitating student learning, perhaps making them prone to discard those pedagogical approaches emphasized in their teacher education programs.

Based on the preservice teachers' descriptions of teaching and learning throughout this experience we found ourselves wondering the following: In what ways were the meanings they constructed linked to the context of this experience? We focus our attention, as Putnam and Borko suggest, on "how various settings for teachers' learning give rise to different kinds of knowing" (2000, p. 6). In doing so we explore both the ideas presented by our participants as well as connections we have drawn based on our analyses of participants' comments and perspectives and our work with these individuals.

Participant connections. To begin, Kary offers an interesting explanation of the difference between learning about science teaching within the context of a one-on-one experience and the context of a whole class experience.

Interview with Kary:

Interviewer: What most surprised you in thinking about yourself as a future teacher

during the interaction you've had with your student partner?
Kary: Probably how frustrated I got at first. I've always thought myself to be pretty patient until I got as frustrated as I did after she didn't hear me the first couple times. I guess the more experience I have with them the more I'll realize just how much it takes to get them to learn certain concepts. That was one of the biggest things.

Interviewer: And that's not necessarily something you picked up on in your experiences out in the schools last semester?

Kary: No, and I don't know if that's because three of us were in the classroom and so there was someone always watching and so they had to pay attention and most of the time…

Interviewer: Were you in charge of that class or mainly observing?

Kary: Twice we were in charge of the class and I never really got frustrated with them. I don't know why. It might have been the material we were presenting and we had more labs to do. Both times I led the class I did labs with them and they must have...I don't know if they really worked because students were able to come up with the answers that I was hoping they would get. So, as I get experience with more students I'll probably start realizing that more are like this experience than last semester.

Interviewer: I wonder, too, what role having just one student plays in your frustration level when you really can tap into…?

Kary: (jumping in) That is probably true now that you say it. Because if you ask, "Does *anybody* know the answer to this question?" one person in that class hopefully knows the answer and I'm just looking for her. I never thought about it that way.

Interviewer: Yeah, it might be very obvious what she does and does not get.

Kary: Yeah, and when you don't have someone else to kind of jump in for you then that's hard. So that's true.

It is interesting to note that Kary mentions that she never really remembers getting frustrated with the class when "presenting" (see her wording in the previous statement) material to them. This comment parallels what Kary wrote in her initial written reflection where she explicitly emphasized that her "patience with presenting ideas in more than one way" was one of her "stronger areas" and that she had always "been a patient person" who understands that different people learn in different ways." Her initial field experience working with a whole class of students reinforced this notion, whereas her work in a one-on-one context contradicted it. After experiencing the frustration encountered during the one-on-one experience Kary began reconsidering what she understood about herself as a teacher based on her initial, more traditional field experience, emphasizing that she didn't know if the labs she was facilitating really worked and stating that as she works with more students, she will probably come to realize that fewer students understood

the information than she had originally assumed.

These comments align with Nuthall's (2004) previously stated idea that teachers often believe that when they teach something, students learn it. Kary initially held this idea. She presented information to the class, felt little or no frustration, got a few students to answer questions about the lab, and assumed students had learned the necessary information. Her method of determining whether or not her teaching was successful was to ask questions to the whole class and use a cumulative student response to determine student understanding, leaving her unaware of whether or not each student understood. On the other hand, in her work with one student, it quickly became apparent what her partner did and did not understand, which resulted in significant frustration for Kary. Notice, too, that her talk about what she does and what the students do seem to be distinct from each other. She says she leads the labs, but she does not know whether or not they really worked, indicating a weak connection between teaching and learning.

However, her one-on-one interactions with her student challenged the meanings of teaching and learning constructed during her previous field experience and caused her to refine her ideas. She now perceives that science teaching is difficult and time-consuming and can cause the teacher to feel significant frustration when students do not understand what the teacher wants them to learn. She also emphasizes that it is likely she will become increasingly aware of moments when certain students have learned and others have not and that learning is less apparent than she originally assumed.

Furthermore, Kary had an interesting epiphany about her teaching pedagogy that she explained to the first author via e-mail after the semester was completed:

> Realizing that I needed to explain the why behind what was happening to my student by showing her in a hands-on way was a big eye opener for me. Coming into the experience I was all about hands-on explanations until I got into the situation and found it easier at first to just explain it verbally. I was completely surprised at myself when I went back and thought about how differently I acted compared to what I believed.

On Kary's initial written response, she explicitly mentioned her commitment to utilizing hands-on activities to engage her learners. However, throughout her initial meetings with her student, her written reflections indicated a consistent emphasis on her student needing a good "explanation" from the teacher. It was not until after her third meeting with her student that she shifted her perspective from one of her student needing a better teacher explanation to one of her student needing the teacher to find ways to demonstrate the concepts and engage students in these demonstrations. Thus, despite her initial belief that engaging students in activities should be her priority, it was not until she repeatedly worked with her student in a more didactic fashion and witnessed again and again that her student was not understanding her explanations that Kary began to shift from being the

teacher that told her student what she needed to know to the teacher that allowed her student hands-on opportunities to experience a phenomena and interpret these experiences.

Kary had not learned this during her middle grades practicum experience the previous semester, during which her primary interactions were with an entire class of students rather than an individual, making it more difficult to discern the learning that was happening as well as the direct connection between students' response to particular instructional approaches taken by the teacher. This experience, then, led Kary to a deeper understanding of the importance of engaging students in activities utilized in the classroom than she had been able to accomplish outside the context of the classroom and while working with an entire class of students.

Two other candidates, Carolina and Tammy, shed additional light on the benefits of the context:

Focus Group Discussion:

> *Carolina*: I just wondered…this time we were one-on-one with the students so we could see whether they understood or not. Then I started thinking about a classroom. I wonder how many leave the classroom without understanding a concept and we don't realize it because there are so many students. It's not like we're one-on-one."
>
> *Tammy*: I think you learn so much about the students because you're doing individual projects. You get a grasp of what they do and don't understand. There are so many different concepts of physical science that you go through that you begin to know what's difficult for the kids and what's not.

Both women emphasize that this one-on-one context allowed them to focus on and construct deeper meaning about the complexity of facilitating student understanding. Carolina points out that working one-on-one with students allowed her to determine whether or not her student really understood the content, which would be much harder to determine within the context of a traditional classroom. Tammy confirms this when she explains how much she learned about students and what they do and do not understand. Clearly, the one-on-one context led preservice teachers to reconstruct their understanding of what is required to ensure students are learning and understanding. As a result, some of these candidates were able to implement pedagogical approaches that diverged from the more traditional ways they tended toward in their initial interactions with students.

One final quote by Raven also speaks to the power of a one-on-one, content-focused context for learning to teach:

Focus Group Discussion:

> *Raven*: Knowing going into Family Science Night that we were the ones that were supposed to be explaining it [the science concept] would have been better. I thought the kids were supposed to explain it. So if you let future students know

> that they're going to be doing most of the explanation on Family Science Night so that the kids can go explore the other stations it would be a lot easier and a lot less stressful.

This statement requires a bit of background information prior to explaining its significance. During Family Science Night, some of the preservice teachers had better success keeping their students at the activity booth than others. As a result, some of the candidates ended up leading the activity booth, even though this was not the role we intended for them. On the other hand, other preservice teachers did make certain their fourth grade students were in charge of teaching the science for at least part of the evening to those who visited their activity booth. This particular statement was made by one of the preservice teachers who ended up explaining the science herself. However, her point is an important one and explicitly links the one-on-one, content-focused experience with the preservice teachers' constructed meanings in two ways.

First, Raven clearly felt significant pressure to make sure her student deeply understood the science concepts underlying her activity since this student was going to be responsible for explaining this concept to and facilitating a corresponding activity with others. Because student partners were ultimately supposed to facilitate the learning of others at the Family Science Night, candidates were encouraged to teach in ways that led to conceptual, deep understanding and to seek various forms of evidence in assessing whether or not their student partners truly understood the ideas well enough to help others learn. Being able to spit back information to the teacher was clearly insufficient to achieve the intended outcome, which encouraged candidates to strive for depth of understanding in their work with students.

Second, Raven's frustration regarding the structure of this service-learning experience also made her feel accountable for whether or not this learning took place. This is significant. Unlike Nuthall's (2004) notion that many teachers believe students are responsible for what is taught once it has been taught, Raven and other beginning teachers saw student understanding as *their* responsibility. If students did not understand, the preservice teachers linked this lack of comprehension to their own actions and sought different instructional approaches to achieve understanding.

Researcher connections. Beyond the explicit links drawn by participants' between the context and their constructed meanings, we identified various connections between the context and the constructed meanings in our interactions with candidates. These were not explicit in the data we collected due to the nature of the questions we asked participants. However, they are worth considering and are supported by our observations throughout the semester. As many of the participants mentioned, being able to work with just one student for an hour a day on seven different occasions allowed them to figure out how their respective students learned, what worked well in interacting with their students, and what their students understood. Had the preservice teachers each worked with several students, rather

than just one, it seems it would have been more difficult for them to determine to what extent each student understood the content, as well as easier for them to focus on their own instruction as disconnected from their learners' understandings. Often, the preservice teachers wrote in their weekly reflections that all had gone well in their instruction, but then realized the following week that students did not remember the information or really understand what they had learned previously. Thus, from our perspective *repeated* meetings with *one* student were critical to the meanings constructed by our students.

Implications

This study holds one primary implication for teacher educators who often design and structure field experiences for preservice teachers. The findings suggest that if preservice teachers interact with students in certain contexts, they can become very focused on the intricacies of learning, rather than becoming almost obsessed with being in front of a class of students (Kagan, 1992). We believe constructing meaning regarding the complexities of helping students learn is a critical component of preservice teacher education that should not be one of the last aspects of teaching on which preservice teachers focus. In light of our findings, we believe teacher educators should continue to seek ways to design learning experiences that encourage candidates to wrestle with the complexities of student learning and their preconceptions about the nature of teaching as well as other pertinent preconceptions as early as possible.

The meanings our teacher candidates constructed in this non-traditional experience beg the following questions: With what sorts of preconceptions can preservice teachers wrestle within the context of more traditional, whole class field experiences? What becomes the dominant focus in this context and what goes less noticed without scaffolding, support, or a different context? The more traditional field experience that combines trying to manage 30 students, working in another teacher's classroom, being a teacher when perceived as a *student* teacher in the eyes of the students, and teaching for the first time seems to naturally de-emphasize a focus on student learning.

Of course, in conversation and upon reflection preservice teachers will still emphasize the importance of helping students learn, but if we really want them to prioritize and understand the intricacies of student learning it is imperative that we remove some factors, allowing them to wrestle with the nuances of learning for at least for one field experience. This is especially imperative in light of preservice teachers' development, which may make it difficult for them to focus on too many different factors at once (Bransford, et al., 2005). In order for preservice teachers to shift their gaze from teacher to the learner at some point during their teacher education program, we must engage them in learning experiences that allow for a predominant focus on student learning "rather than an environment where successful teaching and controlling students are the dominant concerns" (Korthagen, Loughran, & Russell, 2006, p. 1029). Only then will they be constructing under-

standings about the complexities of student learning that will be more likely to persist upon entering the field. Experiences like these have the potential to reduce the disparities observed by teacher educators between what beginning teachers desire to do and what they actually enact their practice.

Thus, this study provides teacher educators with additional incentive to consider the following questions: What alternative field experiences have the potential to provide rich learning experiences in which candidates can examine the nuances of student learning and enter the field more capable of perceiving teaching as a way to support student learning rather than something a teacher does to students? In what ways might we be able to facilitate our candidates' learning to teach, while doing so in ways that are also beneficial to the schools, teachers, and students with whom we work? And what are the implications of this work in an increasingly diverse society?

References

Boyle-Baise, M. (2002). *Multicultural service learning: Educating teachers in diverse communities*. New York: Teachers College Press.

Bransford, J., Derry, S., Berliner, D., & Hammerness, K. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 40-87). San Francisco: Jossey-Bass.

Britzman, D. P. (2003). *Practice makes practice: A critical study of learning to teach (Revised edition)*. Albany, NY: State University of New York Press.

Bruner, J. S. (1960). *The process of education*. Cambridge, MA: Harvard University Press.

Bullough, R. V., Knowles, J. G., & Crow, N. A. (1992). *Emerging as a teacher*. London, UK: Routledge.

Campus Compact (Ed.). (2003). *Introduction to service-learning toolkit* (2nd ed.). Providence, RI: Campus Compact.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Thousand Oaks, CA: Sage.

Cone, D., & Harris, S. (2003). Service-learning practice: Developing a theoretical framework. In C. Compact (Ed.), *Introduction to service-learning toolkit: Readings and resources for faculty* (pp. 27-39). Providence, RI: Brown University Press.

Cook, P. F., & Young, J. R. (2004). Face-to-face with children. *Journal of Curriculum Studies, 36*, 341-360.

Crawford, B. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching, 44*(4), 613-642.

Darling-Hammond, L., Hammerness, K., & others (2005). The design of teacher education programs. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world* (pp. 390-441). San Francisco: Jossey-Bass.

Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

Eyler, J. S., Giles, D. E., Jr., Stenson, C. M., & Gray, C. J. (2003). What we know about the effects of service-learning on college students, faculty, institutions, and communities, 1993-2000, third edition. In C. C. (Ed.), *Introduction to service-learning toolkit* (2nd

ed., pp. 15-19). Providence, RI: Campus Compact.

Feiman-Nemser, S. (2001). Helping novices learn to teach: Lessons from an exemplary support teacher. *Journal of Teacher Education, 52*(1), 17-30.

Hammerness, K., Darling-Hammond, L., Bransford, J., & others (2005). How teachers learn and develop. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world* (pp. 358-389). San Francisco: Jossey-Bass.

Jones, M. G., & Vesilind, E. M. (1996). Putting practice into theory: Changes in the organization of preservice teachers' pedagogical knowledge. *American Educational Research Journal, 33*(1), 91-117.

Kagan, D. M. (1992). Professional growth among preservice and beginning teachers. *Review of Educational Research, 62*(2), 129-169.

Kleiber, P. B. (2004). Focus groups: More than a method of qualitative inquiry. In K. deMarrais & S. D. Lapan (Eds.), *Foundations for research: Methods of inquiry in education and the social sciences* (pp. 87-102). Mahwah, NJ: Lawrence Erlbaum Associates.

Korthagen, F., Loughran, J., & Russell, T. (2006). Developing fundamental principles for teacher education programs and practices. *Teaching and Teacher Education, 22*, 1020-1041.

LeCompte, M. D., & Preissle, J. (1993). *Ethnography and qualitative design in educational research* (2nd ed.). New York: Academic Press.

Lortie, D. C. (1975). *Schoolteacher*. Chicago: University of Chicago Press.

McGinnis, R., Parker, P., & Graeber, A. (2004). A cultural perspective of the induction of five reform-minded beginning mathematics and science teachers. *Journal of Research in Science Teaching, 41*, 720-747.

National Research Council (2000). *How people learn: Brain, mind, experience, and school* (Exp. ed.). Washington, DC: National Academy Press.

Nuthall, G. (2004). Relating classroom teaching to student learning: A critical analysis of why research has failed to bridge the theory-practice gap. *Harvard Educational Review, 74*(3), 273-306.

Orland-Barak, L., & Yinon, H. (2007). When theory meets practice: What student teachers learn from guided reflection on their own classroom discourse. *Teaching and Teacher Education, 23*, 957-969.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Pickeral, T. (2003). Partnerships with elementary and secondary education. In B. Jacoby & Associates (Eds.), *Building partnerships for service-learning* (pp. 174-191). San Francisco: Jossey-Bass.

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teaching learning? *Educational Researcher, 29*(1), 4-15.

Wideen, M., Mayer-Smith, J., & Moon, B. (1998). A critical analysis of the research on learning to teach: Making the case for an ecological perspective on inquiry. *Review of Educational Research, 68*(2), 130-178.

Wilson, S. M., Floden, R. E., & Ferinni-Mundy, J. (2001). *Teacher preparation research: Current knowledge, gaps, and recommendations (Document R-01-3)*. Seattle, WA: University of Washington Center for the Study of Teaching and Policy.

Windschitl, M. (2003). Inquiry projects in science teacher education: What can investigative experiences reveal about teacher thinking and eventual classroom practice? *Science Education, 87,* 112-143.