INVESTIGATING HOW NONTRADITIONAL ELEMENTARY PRESERVICE TEACHERS NEGOTIATE THE TEACHING OF SCIENCE

Mythianne Shelton

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George E. Glasson (Chair)
Brenda R. Brand
Mary A. Barksdale
Ann M. Roberts

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Investigating How Nontraditional Elementary Pre-service Teachers Negotiate The Teaching Of Science

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Abstract

This qualitative study was designed to investigate the influences on nontraditional pre-service teachers as they negotiated the teaching of science in elementary school. Based upon a sociocultural theoretical framework with an identity-in-practice lens, these influences included beliefs about science teaching, life experiences, and the impact of the teacher preparation program. The study sample consisted of two nontraditional pre-service teachers who were student teaching in an elementary classroom. Data, collected over a five-month period, included in-depth individual interviews, classroom observations, audio recordings, and reviews of documentations. Interviews focused on the participants' beliefs relating to the teaching of science, prior experiences, and their teacher preparation program experiences relating to the teaching of science. Classroom observations provided additional insights into the classroom setting, participants' teaching strategies, and participants' interactions with the students and cooperating teacher. A whole-text analysis of the interview transcripts, observational field notes, audio recordings and documents generated eight major categories: beliefs about science teaching, role of family, teaching science in the classroom, teacher identity, non-teacher identity, relationships with others, discourses of classroom teaching, and discourses of teachers. The following significant findings emerged from the data: (a) the identity of nontraditional student teachers as science teachers related to early life experiences in science classes; (b) the identity of nontraditional student teachers as science teachers was influenced by their role as parents; (c) nontraditional student teachers learned strategies that supported their beliefs about inquiry learning; and (d) nontraditional student teachers valued the teacher preparation program support system. The results from this qualitative study suggest that sociocultural theory with an identity-in-practice lens provides a theoretical framework for understanding the influences that affect why nontraditional pre-service teachers select strategies to teach science in the elementary classroom.

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Chapter One: Introduction

This study begins a discourse on how beliefs about science teaching, the influence of life experiences, and teacher preparation programs for nontraditional student teachers impact their identity development as science teachers in the elementary classroom. Specifically, I argue that these factors will affect the strategies that nontraditional, pre-service student teachers utilize to teach science. At a time when teacher preparation programs designed for more traditional students are increasingly being asked to train more nontraditional students to teach in today's schools, they must embrace the changing student demographics and determine how postsecondary institutions are going to meet the needs of this diverse student population. This dissertation suggests that the identity of nontraditional students as science teachers is influenced by a variety of experiences—and that those experiences affect the strategies they select to teach science in the elementary classroom.

This qualitative study was designed to investigate how two nontraditional students negotiated the teaching of science during their student teaching field placements. With little available research on nontraditional pre-service student teachers, this study examined various influences on their identity development as science teachers and what affected their selection of strategies used to teach elementary school science. The term "strategy" includes instructional strategies, teaching techniques, and teaching methods. A teacher's instructional strategies can be broadly grouped as being either teacher-centered or student-centered. For example, lectures and demonstrations are considered more teacher-centered strategies; in contrast, hands-on laboratory activities and projects are more student-centered. Research suggests that most teachers will use strategies that align with how they learn best (Stitt-Goheds, 2001). However, there may be other factors that influence teachers in their selection of the strategies they use to teach science. This study seeks to understand what influenced the strategies they utilized as pre-service science teachers.

Nontraditional Students

According to The National Center for Education Statistics (NCES), postsecondary educational institutions are experiencing changes in their student demographics (NCES, 2011). The "typical" traditional undergraduate student enrolls in college immediately after high school graduation, attends on full-time basis, and completes his or her bachelor degree program requirements within four or five years. Traditional students are usually financially dependent on others and do not have children. Conversely, the NCES defines a nontraditional student as having one or more of the following characteristics: does not enter postsecondary education immediately following high school, attends part-time for at least part of the academic year, works full time, is financially independent, has dependents other than a spouse, or has a GED (General Educational Development) degree instead of a high school diploma. According to these criteria, nontraditional students are not defined by age, but rather by their identity, life experiences, and educational path. For the purposes of this study, a student is considered to be nontraditional if he or she exhibits at least two of the NCES characteristics.

Although most colleges still have more "typical" traditional students, many are seeing an enrollment increase in the number of nontraditional students. For instance, in 2008, 36% of postsecondary students were age 25 or older, and 47% of them were financially independent (NCES, 2011). The NCES (2011) reported that just 15% of college undergraduates attended four-year colleges and lived on campus, while 43% of them attended two-year institutions. The NCES also indicated that 37% percent of undergraduates were enrolled part-time and that 32% of them worked full-time (2011), indicating that the “typical” undergraduate is more financially independent and more likely to attend a two-year college. Additionally, the U.S. Department of Education (2009) projects that from 2006 to 2017, postsecondary enrollment of students age 25 and over will increase by 19%.

With the undergraduate student population changing, colleges and universities must understand how nontraditional students bring a different set of expectations to the teaching and learning experience (Pelletier, 2010). Recognizing the change in college demographics is especially important for teacher education programs in preparing their students to be successful elementary science teachers. With more nontraditional students entering teacher preparation programs—coupled with the lack of literature relating to nontraditional pre-service teachers teaching science in the elementary classroom—this study elucidates how nontraditional students are negotiating the teaching of science.

Prior Beliefs and Life Experiences

An important premise for this study is that learning is an active process that builds upon life experiences. Just as learners build on prior knowledge and experiences to develop an understanding of their world, pre-service teachers use that same process when selecting strategies to teach science in the elementary classroom. In so doing, pre-service teachers generate new rules and mental images in order to construct new meanings (Yager, 1991). Since learning is also guided and influenced by a person’s epistemology, it is necessary to examine what influences nontraditional pre-service teachers’ views on knowing and knowledge as they relate to science teaching (Tillema & Orland-Barak, 2006). Most, if not all, student science teachers enter teacher preparation programs with set of preexisting beliefs about science and how to teach it. As such, those beliefs are likely to have a distinct bearing on preferred approaches for teaching science (Zeichner & Gore, 1990). Research confirms the need to understand how teacher beliefs about science influence their teaching practices (Hewson, Kerby, & Cook, 1995; Tsai, 2002). Given that Richardson (1996) maintained that beliefs develop from the accumulation of prior home- and school-related experiences, this study investigates the influential of prior experiences on the strategies selected to teach science.

Kagan (1992) asserted that students tend to remember their school experiences and how they were taught, which later impacts their own pedagogical development. Similarly, Powell (1992) and Hollingsworth (1989) stressed the link between pre-service teachers' prior experiences and their subsequent development as teachers—e.g., their selection of strategies used to teach their chosen subject in the classroom. Based on this theoretical foundation, this study seeks to identify how prior K-12 and post secondary school-related experiences could influence how pre-service teachers develop as elementary science teachers.

Identity Development

A number of factors influence the identity development of nontraditional pre-service science teachers, and specifically the strategies they prefer to teach science in the elementary classroom. Nontraditional students enter into their teacher preparation program having to manage multiple identities; for example, a nontraditional student may also be a spouse, a breadwinner, and/or a parent. Eiffler and Potthoff (1998) described nontraditional students as adults who return to school on either a full- or part-time basis, while trying to balance employment, family-related tasks, and other responsibilities. Similarly, Rao (2004) spoke of how nontraditional students often delay enrollment due to multiple responsibilities. Knowles (1998, 1990) discussed how nontraditional students are characterized by their many life experiences and significant knowledge base. Given these multiple roles, nontraditional students bring a variety of experiences that can influence how they teach science in the elementary classroom.

Beginning at birth, a person's identity is molded via their experiential interactions with other people and the surrounding environment (Beijaard, Meijer, & Verloop, 2004), resulting in the formation of personal beliefs, values, and attitudes (Williams, 20011). Thus, a pre-service teacher's identity is subject to modification based on his or her interactions with other educational professionals and students. Because this study focuses on nontraditional pre-service science teachers, I will investigate the formation of their identities as science teachers and how new ways of interacting with other educational professionals and students may influence strategies selected to teach science.

Teacher Preparation Programs

Teacher preparation programs can have a powerful influence on teacher education (Bullough et al., 2002). When pre-service teachers enter elementary classrooms, they must negotiate their professional growth, knowledge construction and distribution, and how they will influence student learning. Pre-service teachers use their acquired skills and knowledge to develop pedagogical content knowledge, and to reflect upon their practice (Nuangchalerm, 2009; Nuangchalerm & Prachagool, 2010). Skilled teachers can be very influential on their students' academic achievement, as well as attitudes and beliefs (Darling-Hammond, 1994). As student demographics change, teacher preparation programs are challenged to provide essential tools to nontraditional students so that they can be successful science teachers. Understanding that a relationship exists between knowledge and practice (Cochran-Smith & Lytle, 1999), the question is how teacher preparation programs can influence identity development as a science teacher and the strategies used by nontraditional student teachers in the teaching of science in the elementary classroom.

The framework for understanding these issues can be found in the very foundation of teacher preparation programs: apprenticeship and identity-in-practice experiences (Lave & Wenger, 1991; Wenger, 1998). Lave and Wenger advocated the idea of legitimate peripheral participation where apprenticeships (i.e., student teaching) help to move the student towards full engagement. Wenger later expanded upon the idea of situated learning to include communities of practice known as identity-in-practice. Learning often requires social participation. Identity-in-practice requires an individual to be an active participant in social communities and in the construction of his/her own identity through these communities.

Purpose and Research Questions

Prior to solidifying the design of this study, I carried out a pilot study to examine how a single nontraditional pre-service teacher's different identities influenced her approach to science education in the elementary classroom. Based on qualitative findings from the pilot study, the following overarching goal emerged: To explore the impact of prior beliefs about science teaching, the influence of life experiences, and the impact of the teacher preparation program on strategies that nontraditional pre-service teachers select to teach science in the elementary classroom. In short, this study explored the relationship between identity development and how nontraditional pre-service teachers negotiated the teaching of science and the selection of specific pedagogical strategies.

Little is known about how nontraditional pre-service teachers approach teaching science in the elementary classroom. Given that nontraditional students must manage multiple roles, they tend to enter postsecondary institutions with more life experiences than the "typical" traditional student (Kirby, et al., 2003; Merrill**,** 1999; Skeggs, 1997). Important to this study is that data indicates that the nontraditional student population is on the rise at the postsecondary level (Redd, 2007; Schuetze & Slowey, 2002; Choy, 2002). Thus, it is valuable for teacher educators to understand how teacher preparation programs influence the identity development of nontraditional students as science teachers and the strategies they use to teach science. This study offers educational researchers and teacher educators a more acuminous lens to examine the specific factors that influence the identity development of nontraditional students as science teachers. This research also affords an opportunity to examine how nontraditional pre-service teachers position themselves in the classroom. As such, the results of this study can help educators better prepare nontraditional pre-service teachers for their field experiences.

The following research questions guided this study in understanding how nontraditional elementary pre-service students negotiated the teaching of science in the elementary classroom:

1. *How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?*

2. *How do teacher preparation programs influence the identity development of nontraditional students as science teachers?*

Summary of Chapter One

The rationale for this study relies on the body of research related to learning experiences and how such experiences influence nontraditional pre-service teachers in teaching science. Grossman (1990) and Lave and Wenger (1991) asserted that the ways that people learn are directly related to their identity. Throughout life a person's identity is molded and modified as a result of their experiential interactions with other people and the surrounding environment (Leder & Forgasz, 2004; Beijaard et al., 2004). In comparison to "traditional" students, many nontraditional undergraduate students are balancing school, work and family (Horn, 1996). These different identities were brought to the forefront as a result of a pilot study I conducted with a single individual who spoke at length about her multiple identities as a student, mother, and teacher. Given the multiple identities of nontraditional pre-service teachers, this study also examined what influence these different identities had in fulfilling science instructional responsibilities in the elementary classroom.

By linking nontraditional pre-service teacher's different identities to the strategies used in teaching science, this study is expected to provide a resource for teacher education researchers and teacher preparation programs in understanding the influence of identity on elementary school science teaching. As a related goal, I also expect this study to contribute to the growing body of research related to nontraditional pre-service teachers and what influences their selection of strategies used to teach science. With the literature being limited as to how nontraditional pre-service teachers negotiate the teaching of science, this study may provide an entry point in the developing conversation about this dynamic postsecondary population. By exploring how nontraditional students capitalized upon their beliefs, life experiences and teacher preparation programs in their selection of specific science teaching strategies, this study provides a more extensive view into their development as elementary science teachers. The following chapter reviews the current literature on nontraditional students, connections to sociocultural theory, views and beliefs of pre-service teachers, and elementary school science education.

Chapter Two: Literature Review

Introduction

This literature review is based on the premise that nontraditional students in an undergraduate elementary teacher program have unique experiences that influence their understanding of science and the teaching strategies that they use. Taking into account that nontraditional elementary pre-service teachers are under-represented in science, math, engineering, and mathematics (STEM) education, this review also considers interventions designed to increase science teacher representation at the elementary school level. Additionally, this chapter reviews supporting literature describing today's college populations, with a particular focus on enrollment trends related to nontraditional students. Articles on the following topics were reviewed: nontraditional students, sociocultural theory as related to identity teacher beliefs, and teaching elementary school science.

Beginning in the 1980s, there has been an increase in the number of nontraditional students with dependents entering into teacher education programs (Bean & Metzner, 1985). With this trend in mind, it is important to examine the multiple roles that these nontraditional students must maintain and how their identity influences their progression in becoming an elementary school science teacher. This review of the literature is divided into three sections. The first section will discuss some of the general characteristics exhibited by nontraditional students. The second section considers the sociocultural theories that impact this study. Finally, the third and final section examines the views and beliefs of pre-service teachers.

Nontraditional Students

With multiple definitions currently describing nontraditional students, it was essential to examine the commonalities in order to establish a single working definition that helped to guide this study. Two emerging commonalities are that nontraditional students have multiple responsibilities, and that they tend to delay college enrollment. The following sections consider the various characteristics (e.g. age, marital status) of nontraditional students in teacher preparation programs, and how they impact success in teaching science in the elementary classroom.

Definition of a Nontraditional Student

The literature defines nontraditional students as including a broad number of student types: returning students, adult learners, veterans, single parents, reentry students, empty nesters, or displaced homemakers (Chapagne & Petitpas, 1989). More recent reports tend to agree that nontraditional students as adults who are 26 year of age or older, working full time, and attending school part-time (Ausburn, 2004; Cappelli, 2003; Shea, 2002). Similarly, the NCES (2000) described nontraditional student as someone who delays enrollment, works full-time, attends school part-time, is fully independent with dependents, single or divorced, and has not completed a college degree. These NCES categories align with the Applied Information Management Institute (1997), which labeled nontraditional students as being older than the "typical" college student, attending college part-time, living off campus with dependents, and working full-time. Similarly, Weber State University (2010) classified nontraditional students as those who are 25 years or older, married or divorced, and may or may not have children. Osborne, Marks, and Turner (2004) described nontraditional students as those who delay entry into college after having completed high school.

Given these diverse definitions, it becomes problematic as to which characteristics to include when determining how many students are nontraditional on any given college campus. However, it appears that most researchers base their definition of a nontraditional student on the following characteristics: age, employment status, marital status, college enrollment status, having dependents, and whether the student is attending college for the first time (Ausburn, 2004; Cappelli, 2003; Shea, 2002). Furthermore, the literature revealed that nontraditional students also share common characteristics that either influence their decision to attend college or hinder their completion (Weiss, 1999).

Reasons for Attending Post Secondary School

Nontraditional students have cited a number of reasons for not attending college: lack of motivation, financial constraints, competing family responsibilities, immaturity, and the inability to maintain focus (Bauer & Mott, 1990). However, not having a college degree can present a stumbling block in terms of job advancement (or even initial job placement) (Aslanian & Brickell, 1980). As a consequence, "The ever upward progression of an educated adult population and workforce and high-paying jobs might be the single most powerful factor in the increase of adult learners returning to college" (Aslanian & Brickell, p. 129). As reported by Bauer and Mott (1990), nontraditional students are now better equipped, for a variety of reasons, to fulfill their personal goal of attending college.

Many midlife adults are faced with "triggers and transitions" (Aslanian & Brickell, 1980, p. 129) that then make a college education a more viable, or even an essential, option; Such triggers include marriage, divorce, the death of a spouse, or simply greater maturity that leads to a wish for enhanced self-fulfillment. These life transitions often necessitate the acquisition of new knowledge, skills, and/or credentials, which lead many people back to college (Aslanian & Brickell).

Financially Independent

Horn (1996) defined a financially independent student as a learner who does not rely on others for financial support in college. In 2005, *US News and World Report* (2005) indicated that a financially independent person was likely to claim one or more of the characteristics: age 24 and older, a veteran of the armed forces, orphaned or ward of the court, married, having a child or other dependents or in graduate school. Similarly, an individual or family is considered to be financially independent if they are able to personally pay for at least two of the three major expense categories: housing, food, and other living expenses. It is important to note, however, that although many nontraditional students are considered to be financially independent according to those criteria, many do receive financial aid to help meet their financial responsibilities. Many nontraditional students find that colleges are less likely to provide adjustments for expenses such as married student housing or providing family health insurance. As a result, many nontraditional students with families must be employed—or a spouse will have to work while the other is attending school.

Dependents

The definition of a dependent is anyone else living with the nontraditional student who will be receiving more than half of their total support from that person; a spouse is not considered a dependent. Thus, dependents can include children, parents and grandparents. Support for a dependent is typically in the form of money, gifts, housing, clothes, food, loans, payment of college cost, medical, and dental care (FAFSA, 2006). For single nontraditional students, they may be the only means of support for their dependents, thus potentially creating more stress on this cohort of students.

Nontraditional students who enter postsecondary classrooms have to find a way to function within a world that may be new to them, while adjusting to the extra time commitments required by academia. However, researchers indicate that nontraditional students are more interested and dedicated in their education pursuits. For example, studies show that mature women return to college with a serious purpose and greater motivation in comparison to their younger female counterparts (Cless, 1975; Hechinger, 1975; Markus, 1976). Moreover, nontraditional students—especially those with dependents—must be willing to invest a great deal of time and energy if they hope to do well academically. In a 2003, the New Zealand University Students' Association (NZUSA) conducted a survey of nontraditional students with children. The sampling size was comprised of 84% women and 16% males (Lidgard, 2004). Not surprisingly, NZUSA found that one of the major hurdles that "student-parents" had to overcome was successfully balancing their parent/student roles. Students reported frustration in finding the time to manage college courses while still devoting adequate time and attention to their children (Lidgard). Specifically, they struggled with finding the time to be with a sick child, finding reliable childcare when attending class, and being able to meet financial obligations.

Research suggests that nontraditional students who are parents are faced with many obstacles as they attend higher education institutions. In a UK-based study, Arskey, Marchant, and Simmill (1994) found that nontraditional students were having problems trying to balance work, study, and family obligations. Dewart (1996) conducted a similar investigation in New Zealand among female postsecondary students with children and confirmed that this cohort is likely to experience greater stresses and strains in balancing school and home. Dewart interviewed six mothers who were student teachers. The participants reported that they lacked time, experienced difficulty in meeting family obligations, were afraid of not being successful, felt stress and anxiety, felt the need to prioritize obligations, and felt frustrated in trying balance both family obligations and time to study. In a later study, Heenan (2002) also spoke about how care-giving responsibilities, financial constraints, and lack of career advice hinder women from completing college. Walkup (2006) added that the time constraints associated with managing childcare, academics, and home obligations result in many women feeling guilty over having to make choices between their role as a mother and student.

According to Griffiths (2002) and Lidgard (2004), childcare is the most pressing area of concern for nontraditional students. Many nontraditional students who are parents struggle to find ways to provide quality care for their children due to the reduced amount of time spent at home. As they try to cope with the changes occurring in their lives, nontraditional student-parents find it essential to have friends, co-workers, or family who can champion their educational progress. Thus, research shows that in comparison to traditional younger students, it is critical for nontraditional students to have a strong support base (Bay, 1999; Duncan & Zeng, 2005; Griffiths, 2002; Kantanis, 2002). Kantanis reported that women in particular feel that they need more positive family support, especially from their partner.

Nontraditional student-parents also tend to experience significant financial pressures as well, since they must add predictable college expenses (e.g., tuition and books/supplies) to a long list of other fiscal burdens such as food, housing, and childcare expenses (Astin, 1993; Griffiths, 2002; Lidgard, 2004). For those nontraditional student-parents who major in education and plan on entering the teaching profession, they are required to participate in some type of unpaid field experience and work with a qualified teacher in a classroom setting. Thus, the pre-service teacher assumes the financial burden of travel expenses, teaching supplies, books, and proper attire. In short, nontraditional students who are parents must be able to find some way to navigate through the challenges of work, home and school while successfully managing those oftentimes-competing roles.

In the Classroom

Research involving nontraditional students will frequently compare traditional college students to nontraditional students with respect to important variables, such as academic achievement (Kasworm, 1990), learning processes (Smith & Pourchot, 1998), and classroom instruction and learning styles (Justice & Dornan, 2001). Nontraditional students who enter college classrooms often find themselves in highly competitive environments where they feel that their academic capabilities are in question (Kasworm, 1990). However, Kasworm reported that nontraditional students perform equal to or better than traditional students in two principal areas: grades and aptitude/content tests.

There are good reasons for the comparatively better performance of nontraditional students. By combining new information with their previous knowledge and other life experiences, nontraditional students are able to make better connections to academic content. Moreover, nontraditional students engage in deeper and more comprehensive types of learning than younger undergraduates (Hughes & Graham, 1991; Kasworm, 1997). Donaldson and Graham (1999) discussed how nontraditional students use metacognitive knowledge and abilities to adopt a comprehension-approach to their studies, which enhances their likelihood of success. Graham (1998) pointed out that nontraditional students are more likely to succeed if colleges provide an integrated environment that connects the nontraditional student's learning, personal development, and out-of-class experiences.

According to various adult learning theories, nontraditional students enter higher education institutions ready to learn; they also prefer problem-focused work and are more intrinsically motivated (Knowles, 1980). In general, nontraditional students approach coursework with a more positive attitude, and they are more likely to believe that their course assignments will benefit them in their future endeavors. Dill and Henley (1998) found that nontraditional students are more apt to their complete homework assignments on a regular basis than traditional students, who tend to have a more negative attitude toward homework.

In a recent finding, nontraditional students appear to be motivated by the opportunity to engage in conversations that give them the opportunity to share and apply their life experiences (Jenkins, 2009). In contrast, Jenkins reported that traditional students are likely to place higher value on course credits than assignments or class attendance as a source of academic motivation. Elias (1999) observed that traditional students are more likely to experience higher levels of communication apprehension in the classroom than nontraditional students. In a related finding, research shows that social interactions with peers have more influence on course satisfaction among traditional age students, while teacher-student interactions are a greater source of course satisfaction for nontraditional students (Kasworm & Pike, 1994).

Despite high levels of motivation, nontraditional students do face challenges in the classroom that teachers and administrators must take into account. Smith and Pourchot (1998) discussed how the Zone of Proximal Development and scaffolding should be considered when working with adult learners in order to provide optimal learning. Justice and Dornan (2001) found that older female students are more inherently motivated to learn than either traditional students of either sex or nontraditional males. Despite outperforming their traditional counterparts on grades, Cupp (1991) found that many nontraditional students still lack confidence. To remedy this problem, Cupp insisted that postsecondary institutions need to understand the background of students, their developmental processes, and the context and methodology of nontraditional student learning in order to develop effective programs.

Family, Work and Financial Responsibilities

Despite some of the multiple role-related challenges discussed earlier, the number of nontraditional students attending postsecondary schools is steadily increasing; thus, it is necessary for colleges to familiarize themselves with the needs of their changing populations. According to Leonard (2002), nontraditional students may have more psychological or interpersonal baggage due to their life experiences and responsibilities. While this excess baggage in some instances leads to poor academic performance, it could also add to the "life experiences" factor that enhances learning.

In contrast, some known risk factors for the nontraditional student who enters a postsecondary institution are related to family, work and financial considerations (Ryan, 2003). In order for a nontraditional student to be successful in one environment (i.e., family, work or higher education), there are usually sacrifices made in one or more of the other areas (Zedeck & Mosier, 1990). Family responsibilities are viewed as the main factor for absenteeism, tardiness, and lack of efficiency at work (Zedeck & Mosier). Cardenas, Major and Bernas (2004) analyzed the antecedents and outcomes of the time spent in different roles when an individual is preoccupied with another role. In their study of 171 working mothers, the researchers identified a negative correlation between higher levels of work and family distractions and role quality. According to the scarcity hypothesis, Cardenas et al. proposed that since human energy is limited, the more social roles that a person occupies, the more energy is needed to carry out those roles. For the nontraditional student, this research suggests that family responsibilities may have a negative influence on their success in school. And indeed, Benshoff (1993) reported that, work/financial and family concerns have a considerable impact on the school experiences of many nontraditional students.

As a direct result of having multiple roles to manage, some nontraditional students report that problems arise from lack of childcare, marital conflicts, and providing financial support for their families. However, it is equally important to note that nontraditional students also report that the support and encouragement of family members play a key role in their success and persistence. In keeping with this assertion, research indicates that the presence of family members has a positive effect on the success of the nontraditional student in higher education (Okun, Ruehlman & Karoly, 1991). Similarly, Leppel (2002) reported that being married and having young children tended to enhance motivation levels—especially for men at the university level. Kasworm (2003), however, noted that children could act as either a barrier or an incentive to graduating from college in a timely manner. On the plus side, Kasworm observed that student-parents viewed their children as more of a motivational factor in completing their education. In particular, the researcher described the benefit of nontraditional students who seek to do well academically so they can be good role models for their children.

Connections to Sociocultural Theory

Since this research describes how nontraditional students in an elementary teacher preparation program negotiate classroom science teaching, a sociocultural theoretical framework was used to view how nontraditional pre-service teachers are able to develop their identity as teachers. Sociocultural theory explains how cognitive developmental processes and learning processes are products of a given society and culture (Moll, 1990). Given the fact that different cultures have their own belief systems, values, acceptable behaviors, and practices, socialization within a given culture and society helps to shape an individual's identity.

Culture can influence what people think about, the skills that they regard as important, when they can participate in given activities, and who is allowed to participate in which activities (Miller, 1993). Depending on cultural needs and values, emphasis can be placed on different kinds of communication such as verbal or nonverbal; proficiencies such as reading, mathematics, or spatial memory; and social interaction such as formal schooling or informal apprenticeships (Miller). Rogoff (1990) suggested that a cultural apprenticeship exists between the learner and social agents—for instance when a cooperating teacher shares the tools necessary for successful science teaching. Social interactions such as language are transformed in such a way that the learner is able to access the proper tools needed to complete tasks like thinking and problem-solving (Wertsch, 1985). Thus, social interactions—whether with a cooperating teacher, university supervisor, or even a university professor—are likely to influence the strategies selected to teach science in the elementary classroom.

Dewey (1987) and Vygotsky (1978, 1986) addressed how everyday events and socialization help to guide a learner throughout the educational process. Both researchers emphasized that the learner needs to be at the center of the learning process, which is highly influenced by socialization (Moll, 1990). Focusing on the pragmatic method of inquiry, Dewey (1987) suggested that learning is an ongoing process that incorporates socialization and self-correctiveness as new information is presented to the learner. As an active participant, the learner is given the necessary time to interact with other classmates and with the teacher. For the nontraditional student, this interaction time is particularly important since most are unable to devote copious amounts of time to group work outside of school due to work and/or family obligations. Dewey also asserted that experiences help to form a learner's thinking. As nontraditional students enter colleges and universities, they must be able to assimilate their prior knowledge, beliefs, and experiences with the new information being presented.

In addition to Dewey's (1987) research on the learning process, Vygotsky (1978, 1986) focused more on the learner's cultural experiences and argued that social and cultural aspects of the educational process are intertwined. Upon closer inspection of his work, Vygotsky's position is more centered on how culture influences the learner's thinking processes. In other words, the tools or artifacts that students use influence their cognitive processes as they go about conducting everyday activities. In this case, the term "tool" is a symbolic reference to the language or other strategies a learner will employ to perform tasks. Learners develop their cognitive structures using these tools as they participate in everyday activities such as playing, learning or speaking (Lave & Wenger, 1991; Rogoff, 1990). As echoed by Lave and Wenger, Vygotskian theory takes into consideration how social interactions between parent and child, or teacher and student, impact cognitive activity. With this in mind, the interactions of nontraditional students with family members (e.g., spouse and/or children) may play an integral role in the strategies they prefer for teaching elementary school science.

The theoretical frameworks presented by Dewey (1987) and Vygotsky (1978, 1986) can be used to assist higher education institutions in better serving their nontraditional student population. By knowing and understanding what all learners bring to the educational table, instructors will be better equipped to meet the educational needs of their students. For example, both Dewey and Vygotsky described the importance of inquiry-based learning and the need for socialization in the classroom. Learning is not limited to the school campus; it occurs everywhere. As such, nontraditional students are well positioned to make connections within and between school, work, and family life. Understanding how nontraditional students make these connections can offer insights into the strategies they use to teach science in the elementary classroom.

Identity

Burke and Reitzes (1981) defined identity as "self-meanings that are formed in a particular situations" (p. 84). As a person performs in a certain role, he or she will develop an identity related to that position. Thus, identity can be used to describe a set of group-specific characteristics in connection with being a student, parent, and/or teacher. Beginning at birth, a person's identity is molded via their experiential interactions with other people and the surrounding environment (Beijaard, Meijer, & Verloop, 2004). In general, teacher identity is a function of his or her knowledge, beliefs, self-efficacy, and general attitude toward teaching and how these characteristics are influenced by classroom practice (Drake, Spillane, & Hufferd-Ackles, 2001). A teacher's identity is subject to modification as the individual works with other educational professionals and students.

Identity also relates to the distinctive characteristics that emerge from belonging to one or more social groups (Cote & Levine, 2002). Thus, identity is shaped by both external and internal factors—i.e., social, institutional, historical and personal experiences. Also important to note is that the way we see ourselves and how others perceive us is part of a person's identity…but these two perceptions can be very different. Nonetheless, the literature is persuasive that a person's identity is self-reflective in that it is based on the individual's interpretation of his or her life experiences (Giddens, 1991; Leary & Tangney, 2003).

The formation of identity is an active process that is constantly evolving (Castells, 1997). As discussed, nontraditional college students tend to have multiple identities in play before they enter institutions of higher learning (Merrill, 1999). By adding that new student identity—which as noted could compete with the parent or employee role—they are at risk for added stress. Sandler (1999) found that if nontraditional students had limited financial resources and perceived stress; they were less likely to complete their degrees. Thus, nontraditional students may find it necessary to negotiate the identity interchange that occurs between school and their other identities such as worker, parent, female/male or wife/husband, which can impact the strategies selected to teach science in the elementary classroom.

For Côté and Levine (2002), identity is linked to the concept of agency and structure. Agency is the capacity of individuals to act independently and to make their own choices freely. The term structure refers to situations that influence or limit the choices and opportunities available to individuals. Unger (1987) argued that there were constraints associated with structure that placed limits on an individual's agency. By having multiple roles and commitments, nontraditional students may experience an impaired sense of agency. Thus, when adults return to postsecondary institutions they must find a way to overcome limiting structures and weave their roles together, thereby promoting feelings of empowerment or agency. This process of overcoming structures and developing agency is essential as nontraditional students form and reform their identity.

Merrill (1999) focused on the transformative role of postsecondary education on nontraditional female students in Britain. As noted in her dissertation abstract, "In deciding to return to learn the women were actively choosing to change the direction of their lives." She found that while these women (and especially those with children) initially lacked the confidence in their ability to learn new material, that trepidation changed as they adjusted to their new identity as student. In fact, the student-identity of these women appeared to intensify as they used their agency or their ability to move within their social structures to overcome any unfamiliar structural barriers (Merrill). In fact, the study participants all reported a positive change in their lives and had no regrets in terms of the sacrifices they had to make to return to college. No longer were these nontraditional students only parents or spouses—through education they were able to establish a different identity that they reported to be empowering.

Identity-In-Practice

According to Lave and Wenger (1991), learning is fundamentally a social process—that learners participate in communities of practitioners. Wenger (2000) defined identity as "a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities" (p. 5). He also asserted: "Identity is rich and complex because it is produced within the rich complex relations of practice" (p. 162). The multiple identities that nontraditional pre-service teachers exhibit cannot be compartmentalized, but must be viewed from the perspective of "multi-membership of many communities" (Wenger, p. 159). Wenger also purported that "in practice, we know who we are by what is familiar, understandable, usable, negotiable" (p. 153), as well as what is unfamiliar. It is both the familiar and unfamiliar that defines our identity. To understand how the identity of nontraditional pre-service teachers form, an identity-in-practice lens would be beneficial. Such a lens would provide a detailed understanding of how they frame their teacher identity and what influences their development as science teachers, especially in identifying what influences the strategies they employ to teach science.

Varghese, Morgan, Johnson and Johnson (2005) found that "identity-in-practice" (an action-orientated approach to understanding identity) directly impacts the formation of a person's teacher identity. In other words, a teacher's persona is formed through practice via student teaching placements. The identity formation of a pre-service teacher correlates with Wenger's (1998) construction of identity as an engagement-driven process. Wenger also suggested that engagement gives a person the opportunity "invest in what we do and in our relation with other people gaining a lived sense of who we are" (p. 192). In the pre-service classroom, a student-teacher has the opportunity to use her "teacher's voice" to shape her teacher identity as she incorporates her science knowledge, skills and understanding to select the appropriate pedagogical strategies. Since knowledge is a social construct, identity-in-practice can provide useful feedback on the knowledge that pre-service teachers are able to acquire.

Beliefs of Pre-service Teachers

Due to the lack of research on the views of nontraditional students in science education, we must continue to investigate how prior beliefs influence the success of nontraditional pre-service teachers. Teacher preparation programs face many challenges, including understanding the views held by nontraditional pre-service teachers as they relate to teaching and science. While all students enter the classroom with personal beliefs and views on how science education should be conducted, nontraditional students who are parents bring to the table multiple perspectives that stem from their own experiences with their children's education. As a result of attending parent-teacher conferences, managing their own families, and helping their children with schoolwork, nontraditional students enter the classroom with a greater variety of experiences. These life experiences are likely to enhance their perceptivity when it comes to working with children and may also impact their selection of pedagogical strategies.

Research suggests that pre-service teachers who enter teacher preparation courses believe that good teaching is related to one's content knowledge and the ability to present that information to others (Powell, 1992; Hollingsworth, 1989; Woodlinger, 1985; Weinstein, 1989). Moreover, many elementary pre-service teachers begin their teacher preparation studies believing that "teaching is telling" and that students should reproduce what the teacher has instructed them to do (Feiman-Nemser, McDiarmid, Melnick, & Parker, 1989). Feiman-Nemser et al. suggested a link between a pre-service teacher's disciplinary major and his or her personal belief about teaching. Bruner (1996) referred to these preconceived beliefs as folk pedagogies, while Holt-Reynolds (1992) classified them as personal history-based lay theories that form as a result of the individual's personal experiences and cultural beliefs.

The prior beliefs of pre-service teachers are potentially limiting (Anderson, Corbett, Koedinger, & Pelletier, 1995) and "may not be well adapted to teaching" (Calderhead, 1991, p. 532). Kagan (1992) described teacher beliefs as highly resistant to change and more reflective of the nature of instruction provided by the teacher. Acting as a filter, prior beliefs can greatly influence how other instructional material is interpreted; thus, the information delivered in teacher education program courses and via classroom observations are subject to interpretation and can be easily misconstrued (Kagan). This filtering process can create a learning barrier in that prior beliefs can hinder communications between course instructor and student.

Holt-Reynolds (1992) provided evidence that many pre-service teachers believe that a teacher's role is to pass on knowledge to her students. Teacher education programs, such as the one described in this study see their role as providing pre-service teachers with the ability to produce knowledge (Holt-Reynolds, 1992). With different interpretations as to what a teacher's role is supposed to be, it easy to see how terms such as active learning or inquiry can be misunderstood.

Hollingsworth (1989) described the cognitive changes that occurred in pre-service teachers who were enrolled in a nine-month graduate teacher education program that emphasized reading. As she documented, many pre-service teachers just restructured their beliefs as they related to learning, while others significantly amended their existing beliefs. She then examined any differences in students' "post-program beliefs" in light of how they related to learning. She found that student beliefs tended to be highly reflective of how they learned in school. Similar studies have also been conducted for specific subject areas. For subjects such as mathematics and science, prior beliefs held by pre-service teachers that remain unaddressed (i.e., unexamined) formed barriers to their instruction (Anderson et al., 1995; Kagan, 1992; 1996; Slotta, Chi, & Joram, 1995). Many experienced teachers have established routines that they find difficult to change (Leinhardt & Greeno, 1986). As suggested by Nespor (1987), while teachers do experience personal knowledge growth, it remain strongly linked to the teacher's prior beliefs, regardless of the time spent teaching

Joram and Gabriele (1989) described four beliefs that pre-service teachers have about their program:

> University courses have little to offer prospective teachers; I should be out in the field; I can learn how to become a good teacher by copying my past teachers; and learning and teaching are nonproblematic, and learning is easy, but classroom management is what worries me the most. (p. 179)

In other words, pre-service teachers tend to believe that a hands-on teaching experience in the classroom (i.e., on-the-job training) is the best way to learn how to be a teacher (Joram & Gabriele). The researchers also reported that pre-service teachers did not rank their field-study courses or teacher-methods courses to be as important as having actual hands-on experiences in the classroom.

Calderhead (1988) discussed how pre-service teachers enter college with an idea of what constitutes an ideal teacher, which is based on their interactions with prior classroom teachers. Lortie (1975) referred to this type of profiling as an "apprenticeship of observation" (p. 65). According to Lortie, teachers who model certain observed characteristics reflect such apprentice beliefs. Apprentice beliefs include: "What method of learning works for me will work for all learners" and "My teacher taught this way, I learned, therefore it must be the best way to teach" (Lortie, p. 151).

Kagan (1992) revealed that in some cases, pre-service teachers' beliefs might remain unchanged even after completing their teacher education program—meaning that their personal experiences can supersede even the best teacher education pedagogy. Freese (2006) and Goldstein (2002) discussed that when a pre-service teacher enters into the teaching profession and is faced with challenges, they are more likely to revert back to practices employed by their K-12 teachers, rather than use evidence-based practices learned in teacher preparation program. Goldstein (2002) also saw an increase in the potential for pre-service teachers to become discouraged as they began their field experiences, especially if they were not willing to refashion their ideals and beliefs about themselves and teaching prior to entering into their teacher preparation programs.

In summary, the research makes it clear that prior beliefs are very powerful influences in how an educator structures his or her approach to classroom teaching—such as using strategies that are more constructivist in nature or more traditional. A teacher's prior beliefs can also influence their feelings toward the subject matter that is being taught. Given this cyclic nature of prior beliefs and a teacher's style, it is easy to see how nontraditional students enter college with prior beliefs and experiences that are so deeply rooted that learning new concepts and ideas can be problematic.

Elementary School Science Education

It is important to examine the characteristics that elementary school science teachers share and how those experiences influence their outlook toward science. Studies indicate that many K-12 teachers experience difficulties in teaching science. A survey was administered to the education students at Union Institute and University prior to their student-teaching internship (Baldauf & Hill, 2003; Hill & Baldauf, 2004). This survey analyzed their attitudes towards science and their preparation for teaching natural science in the elementary classroom. The results showed that both pre-service and in-service teachers expressed a lack of confidence in their ability to teach science, specifically life science, earth science, and physical science. Other studies have confirmed that teachers express a lack of confidence and exhibit low self-efficacy with regards to teaching science (Mulholland & Wallace, 2000; Appleton, 2003; Mulholland, Dorman, & Odgers, 2004). If we know that teachers lack confidence in teaching science, a closer examination of the strategies used to teach science would afford a better understanding of what influences a teacher's decision to use certain strategies when working with elementary students. Moreover, since nontraditional students are entering the teaching ranks in increasing numbers, it is important to understand the unique contributions that this population of teachers may have on the teaching of elementary school science.

Inquiry-Based Learning

Typically, science education involves both teaching content, and enabling students to solve problems through the use of process skills and hands-on activities. Inquiry-based learning allows students, regardless of educational level, to participate in a richer learning experience and to build upon prior knowledge (Bruner, 1961; Dewey, 1938). Even though documents such as *No Child Left Behind of 2001* (NCLB, 2003), *National Science Education Standards* (National Committee on Science Education Standards and Assessment, National Research Council, 1996), and the *Virginia Science Standards of Learning* (Virginia Department of Education, 1995) state the importance of using inquiry methods to help students master science content, many elementary school teachers choose not to do so. According to Ford (2008), teachers with a sound understanding of pedagogical content knowledge and inquiry-based learning are able to provide better examples, explanations, and demonstrations that help their students to understand new material and make connections with their prior knowledge. The research provided by Appleton (1997), Black (2006), Windschitl & Thompson (2006), and Zembylas & Barker (2002) support the idea that if pre-service teachers experience inquiry-based learning, their self-perceptions of science and their confidence in teaching science will improve.

Successful Teaching Competencies

Deakin Crick (2008) defined competence as "a complex combination of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world, in a particular domain. Competence implies a sense of agency, action and value" (European Commission, 2011, p. 2). The literature indicates that there is a strong relationship between teacher competence and effective teaching. Effective teaching employs the ability of a teacher to provide instruction that accommodates the different learning needs of their students, while integrating related instructional objectives and subsequently assessing the success of the strategy used (Vogt, 1984).

Studies by Powell (1992) and Hollingsworth (1998) that looked at pre-service teachers' content knowledge and their ability to communicate with their students confirmed that teachers need to have knowledge of good pedagogy in order to convey the subject matter to their students. It is important that teachers have the proper training to develop as adept teachers who are confident in their own abilities and who understand how to tap into the potential of each student in their classroom (Wade & Moor, 1992). In order to foster confidence and help pre-service teachers develop good pedagogical practices, teacher preparation programs must take into consideration the attitudes, expectations and perceptions of student teachers (Pajares, 1992). As discussed earlier, the perceptions of student teachers regarding teaching competencies are influenced by the teaching styles and methods implemented by their former teachers (Frank, 1990; Fulton, 1989; Goodland, 1990; Handler, 1993). To assist pre-service teachers in their development as successful classroom teachers, teacher preparation programs should incorporate examples of these personal competencies within their courses.

Additionally, by encouraging pre-service teachers to incorporate specific strategies in their classroom instruction such as motivating students, displaying a positive attitude toward learning, creating personal rapport, and maintaining a dynamic learning environment, students are more likely to succeed (Pinata, 1999; Medley, 1977; Watson, 2003). Lowman (1984) asserted that successful teaching occurs when teachers are able to form more interpersonal relationships with students and intellectually inspire them. The incorporation of such strategies can enhance a student's self-concept, especially when a teacher is more willing to extend emotional and social support during class instruction (Lowman, 1984). Kohll (1992) emphasized the fact that a capable teacher must not only be knowledgeable about the subject matter, but must also have an understanding of society's needs and how course content can apply to those needs.

Effective communication skills are essential for conveying content and facilitating meaningful student-teacher interactions in order to assist them in meeting their educational goals (Mukhopadhyay, 1994). Good communication helps teachers build relationships with both students and parents that then promote trust. Teachers need to be adept at conveying both verbal and nonverbal messages in the classroom (Sprinthall, Sprinthall, & Oja, 1994). Effective communication also enables teachers to apply disciplinary strategies more skillfully, as well as encourages reflection and discussion—all of which foster a more productive learning environment (Ur, 1996).

Effective communication is just one strategy used by successful classroom teachers. Leadership is also an important quality of an effective classroom teacher. Teachers exhibiting strong leadership qualities are more likely to use innovative instructional strategies in their classroom (Ovando, 1996). Teachers with stronger leadership qualities are also better decision makers, knowledge facilitators and motivators (Ovando). Rather than being imperious, a skilled leader will inspire students to be more motivated. Since nontraditional students bring a variety of skills, abilities, and experiences to the classroom, they have the potential to develop into teacher-leaders who can effectively teach, motivate, and encourage students (Lieberman, Saxl, & Miles, 2000).

Summary of Literature Review

While no single definition adequately describes a nontraditional student, we know that researchers use established characteristics in defining this population. These include age, marital status, college enrollment status, level of employment, dependents, and whether the student is attending college for the first time. For example, the NCES (2000) describes the nontraditional student as someone who delays enrollment, works full-time, attends school part-time, is financially independent with dependents, is either single or divorced, and has not completed a college degree. Despite these various indicators, the literature is unanimous in that the majority of nontraditional students are required to juggle their educational responsibilities with demands such as family and work (Mooney, 1994; Kirby et al., 2004). For many nontraditional students, this means personal sacrifices that relate mainly to family and finances. As a result, nontraditional students may face possible resentment from family members because of the lack of time spent at home, or their inability to meet all of demands of having a family such as helping children with homework, cooking meals, or driving children to school.

The literature cites that nontraditional students enter the college classroom with a variety of prior beliefs that are reflective of how they learned when they were younger (Hollingsworth, 1989). Oftentimes those prior beliefs can influence how a student forms new understandings about mathematics and science. If these prior beliefs go unaddressed, barriers can form that may directly affect their classroom instruction abilities (Anderson et al., 1995; Kagan, 1992; Slotta et al., 1995). As nontraditional pre-service teachers progress through their educational program, it is critical that course instructors understand how influential prior beliefs and experiences are in the assimilation of knowledge and the ability to convey that knowledge to their students.

The self-efficacy literature reviewed herein was illuminating. For example, research confirms some important gender differences with respect to teaching science. Specifically, Levin and Jones (1983) showed that women demonstrate lower self-efficacy when it comes to teaching science in comparison to men. Thus, it is essential that women—and nontraditional students as well—develop a stronger self-efficacy for managing science-related careers, as well as other demanding careers while maintaining a balance with home and family responsibilities (Betz & Hackett, 1987; Lefcourt & Harmon, 1993). Such goals will ensure that women and nontraditional students will pursue science as a concentration or major when they enter into a teacher preparation program. They may also be less inclined to use certain strategies when teaching science. With little literature available targeting nontraditional students who are elementary pre-service science teachers let alone pre-service teachers who are teaching science, this research was designed to fill a scholarly gap—namely, how do the beliefs of nontraditional pre-service science teachers influence the strategies they use to teach elementary school science? By observing nontraditional student teachers in an elementary school classroom, this qualitative study attempts to clarify the impact of beliefs about science teaching, life experiences, and the impact of teacher preparation programs with respect to pedagogical practices.

Chapter Three: Methodology

Introduction

When an elementary school science teacher enters the profession, he or she is automatically charged with the powerful responsibility of helping shape how science is portrayed to their students and what type of person successfully engages in science. In order to understand how nontraditional students in an elementary teacher preparation program negotiate the teaching of science, it is critical to look at the beliefs they hold about science pedagogy. These deeply-seeded beliefs can influence how a teacher approaches the teaching of science, as well as influence the strategies pre-service teachers use to teach science in the elementary classroom. Additionally, the approaches that nontraditional pre-service teachers use may also be influenced by other sources within and outside of the teacher preparation program. As minority students in programs that by and large prepare traditional undergraduates for science teaching, this study sought to understand how nontraditional students develop as elementary science teachers. As an extension of a pilot study that examined how a nontraditional, pre-service teacher experienced an inquiry-base science course, this study investigated a) how the beliefs and life experiences held by two nontraditional elementary students were related to the development of their identity as science teachers; and b) how the teacher preparation program influenced the development of the nontraditional students' identity as science teachers.

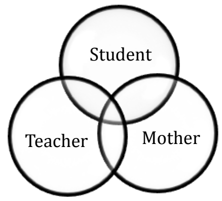
Since ethnography is a qualitative research design that can be used to explore cultural phenomena (Geertz, 1973), this research employed a descriptive case study approach by following two nontraditional elementary education program students as they began their field experience in an elementary science classroom. First, however, the findings from the pilot study are presented, including how those findings warranted a more defined study to better understand how nontraditional students negotiated science teaching in the classroom, after which the study's design and procedures are detailed.

Pilot Study

I first conducted a qualitative pilot study to observe and examine how one nontraditional, undergraduate female pre-service elementary science teacher experienced an inquiry-based physical science course. This course was specifically designed to assist pre-service teachers in improving their science content knowledge, as well as to provide hands-on activities that could be used to assist their future classroom students in comprehending specific science concepts. Since the participant, Candace (pseudonym), was returning to college after being out for an extended period of time, the pilot study specifically looked at how past experiences influenced her initial attitudes towards science, as well as how having children at home influenced her understanding and confidence in teaching science. The pilot study included six classroom observations and three individual interviews designed to help clarify the influences that affected Candace's attitude toward science.

Given that nontraditional students must manage multiple identities, I focused on Candace's various identities (e.g., parent, older-age college student, and pre-service teacher) to understand how each affected the way she viewed science and science teaching. As Candace verbally described how she viewed herself within each role, I was able to better understand how she negotiated her place within each. It was also critical to analyze the discourse that occurred within the intersectional parts of each role and how that may have influenced her thinking about science (Figure 1).

Figure 1: Three Identity Roles of Candace



By reviewing Candace's interview responses and classroom observations, I gained insights into how nontraditional students experience inquiry-based science. As Candace stated, she did not remember experiencing very many inquiry-based activities as a K-12 student. She added that there were fewer inquiry-based activities offered during middle school verses high school. Yet surprisingly, Candace did not have a negative attitude toward science; even though she lacked confidence in teaching science, she did feel that it was important for science to be inquiry-based. As she interacted with her children at home, she understood the importance of children experiencing science through hands-on activities. Candace also expressed how a physical science course designed for pre-service teachers helped to build her confidence in teaching science.

In talking with Candace, it was evident that her two children played a significant role in her identity as a mother, student, and teacher. In fact, in looking at the data in its entirety, Candace's children were key in her decision to attend college. It was also evident that her children were influential in Candace's decision to select elementary education as a major. As a returning student who had limited time and financial resources, Candace had a better understanding of the importance of doing well in school. As a direct result of her attending college, she also wanted her children to take advantage of all the opportunities available to them, especially education. As a parent, Candace understand the importance of learning, but it was not until she enrolled in college to be an elementary school teacher that she understood the importance of having state science standards and how those standards could serve as a guide to comprehending the bigger scientific concepts.

As a student participating in a physical science course designed for pre-service teachers, Candace was able to develop inquiry-based strategies by being an active learner. One of the impacts that the physical science course had on Candace was that it reinforced the criticality of providing examples to young children to help them understand difficult science concepts such as density, electric current, and magnetism. Candace indicated that the general science courses taken as part of her teacher education program helped to foster a better understanding of science, thus leading to having more confidence in teaching science.

This idea of providing examples in explaining science concepts was not new to Candace. As a parent, she understood the importance of modeling to help her daughter understand how tasks should be completed. Her daughter would often sit at the kitchen table with her so that they could work on homework together. Candace would spend time talking with her daughter about what she had learned in the physical science class. As Candace worked on physical science take-home projects, she would let her daughter help.

After talking with Candace, it was apparent that she was doing science with her children long before returning to college. For Candace and her children, they were experiencing science every time they played ball outside, observed fireflies, picked flowers, and cooked in the kitchen. Much like other nontraditional students entering into postsecondary school, Candace found herself having to manage her roles as a student and parent (Cross, 1980). In summary, it was clear that Candace's student, teacher and parental identities were intertwined. The pilot study brought to the forefront how influential children can be in the decision-making process of their parents.

The pilot study confirmed that nontraditional students must contend with managing multiple roles at the postsecondary level. However, this pilot study stopped just short of investigating the role that an elementary education program plays in influencing the strategies that nontraditional students use in teaching elementary school science. By extending the pilot study, I was able to collect additional data relating to a) how the beliefs and life experiences of nontraditional elementary pre-service teachers were related to their identity development as science teachers; and b) how teacher preparation programs influenced the development of nontraditional students' identity as science teachers.

Main Study

Purpose

Many traditional and nontraditional pre-service teachers who enter teacher preparation programs do so with the belief that teaching is no more than telling, and that classroom students demonstrate learning by repeating what the teacher has told them (Feiman-Nemser et al., 1989). Carter (1990) asserted that students enter teacher preparation programs with prior beliefs about teaching and learning—and that these influence how pre-service teachers assimilate and accommodate the new information presented about teaching and learning. Thus, the personal experiences and beliefs of nontraditional students enrolled in undergraduate teacher preparation programs may affect their inculcation of science concepts and their subsequent delivery to K-12 students.

Given that an increasing number of nontraditional students are returning to school, it is important to understand how nontraditional pre-service teachers are able to thrive in programs designed for traditional undergraduate students. Thus, I wanted to understand how nontraditional pre-service teachers were influenced as science teachers by their teacher preparation program, as well as by their beliefs and life experiences. These goals prompted the design of this investigation of the development of nontraditional elementary school science teachers.

Since colleges are experiencing an increase in nontraditional students enrollments, it is essential to understand how nontraditional pre-service teachers experience their teacher preparation program (U.S. Department of Education, 2002). To supplement current educational research and to provide a more intricate portrayal of nontraditional pre-service teachers, the purpose of this qualitative study was to explore how nontraditional elementary pre-service teachers negotiate the teaching of science in the classroom based on a) how their beliefs and life experiences were related to their identity development as science teachers, and b) how teacher preparation programs influenced their identity development as science teachers. This investigation yielded a better understanding of their pedagogical decision-making and the influences that framed their thinking about teaching science. The findings clarified how each participant's beliefs about the teaching of science, elementary teacher preparation program experiences, and other influences aligned with the strategies they selected to teach science. Additionally, the results from this study provide information on the apprenticeship relationship with their cooperating teacher and university supervisor and their classroom instructional strategies as a student teacher.

Research Questions

The following research questions guided this study in understanding how nontraditional elementary pre-service students negotiated the teaching of science in the elementary classroom:

1. *How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?*
2. *How do teacher preparation programs influence the identity development of nontraditional students as science teachers?*

Case Study Design

This qualitative study employed a case study design to explore how two nontraditional students enrolled in an elementary teacher preparation program negotiated their teaching of science during student teaching. Based on the research of Atkinson and Hammersley (1998) and Fetterman (1998), this case study utilized ethnographic methods to collect data via interviews, participant observations, and the collection of other tangible documents that would represent how nontraditional students' beliefs about science teaching, life experiences, and the influences of a teacher preparation program impacted their selection of teaching strategies and development of their teacher identity.

Patton (2002) discussed how research that incorporates case studies gives the researcher more freedom in what will be studied. Yin (2003) found cases studies to be more "beneficial when the boundaries between phenomenon and context are not clearly evident" (p. 13). Grossman, Valencia, Evans, Thompson, Martin and Place (2000) described case studies as valuable because the resulting rich data is able to paint a better picture of the experiences and beliefs of participants. Classroom observations were used as a gateway for understanding the influences that affected the strategies used by each participant to teach science; this allowed me collect real-life data in the context in which it occurred (Yin, 2003). By identifying the strategies selected to teach science and understanding the influences behind that pedagogical selection, I was able to create a more detailed description of each participant's science teacher identity.

In using this approach, I was able to situate myself within each participant's classroom environment long enough to gain acceptance and understanding (Lareau & Schultz, 1996). Thus, the classroom observations facilitated my role as a participant-observer, thus affording a more comprehensive view of how cooperating teacher and classroom dynamics influenced the strategies used to teach science. By observing both participants during science instruction, I was able to identify their specific pedagogical strategies, as well as the reactions of students. Through participant observations, interviews, and the collection of artifacts, I was able to investigate how each nontraditional pre-service teacher's belief about science teaching, life experiences, the teacher preparation program were connected to strategies used to teach science and their professional identity development.

Since a case study is an experiential inquiry that explores a phenomenon within its environment, I used the following first-hand data sources to uncover knowledge of the various influences on each participant's selection of pedagogical strategies (Yin, 2004): one initial 45-minute interview, 5 science lesson observations with teacher interviews occurring before and after each observation, and one final 45-minute interview. During the course of analyzing quotations, descriptions, and artifacts, a single narrative emerged to tell the "story" of each participant (Hammersley, 1990).

Campbell et al. (2004) discussed how professional competence is a key factor in classroom practices. Knowing that a teacher's initial professional competence stems from their teacher preparatory program, this research reveals how each participant's teacher preparatory program influenced their beliefs about science and the strategies selected to teach science. As defined by Strauss and Corbin (1998), "Meaning is defined and redefined through interaction" (p. 9). By carefully analyzing the students' statements and observational data, I was able to identify emerging themes their relationships to the research questions.

Sociocultural Theory with an Identity-In-Practice Lens

By incorporating a sociocultural framework, I analyzed the discourses and practices of the nontraditional pre-service teachers, which enabled me to better understand how each nontraditional participant was able to negotiate elementary school science teaching. According to Vygotsky (1978), sociocultural theory explains how learning occurs via exchange, negotiation, and collaboration. Rogoff (1990) described the sociocultural perspective as a process that allows one to identify and understand the tools that are made available to the learner by social agents such as family members and teachers. By using a sociocultural perspective to frame this research, the relationship between the teacher participants and the social agents that influenced their beliefs about the teaching of science was made more apparent. As stated previously by Horn (1996), many nontraditional undergraduate students must be able to balance school, work and family. This idea of balancing multiple roles was brought to the forefront in the pilot study when Candace talked about her identities as a student, mother, and teacher. As indicated by Grossman (1990) and Lave and Wenger (1991), the ways that people learn are directly related to their identity.

As students of a teacher education program, the identity of each participant was also shaped by the program's required activities, which included course projects and field experiences (Holland et al., 1998). Field experiences gave the pre-service teachers an opportunity to work with experienced teachers and university supervisors. Lave and Wenger (1991) used the idea of legitimate peripheral participation to explain how apprenticeships such as student teaching help to move the participant towards full participation. Given that both participants were student teaching and working with experienced teachers as apprentices, the concept of "apprenticeship of observation" was examined (Lortie, 1975). The discourses of the participants were comprised of multiple interactions with a variety of people, including classroom teachers, university supervisors, and classroom students. According to Lave and Wenger, all activities are situated where the learners participate in communities of practitioners.

I also utilized Wenger's (2000) identity-in-practice as a lens for understanding how the participants framed their identity as science teachers and what influenced their development as a teacher. Therefore, I used an identity-in-practice lens to examine the data collected during this study; in so doing, I was able to learn how participants were able to draw upon their non-student identities and other knowledge sources to develop as science teachers (Tan & Barton, 2007). Moll, Amanti, Neff and Gonzalez (2001) referred to funds of knowledge as "the historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being" (p. 133). The nontraditional pre-service teacher's fund of knowledge includes the knowledge gained from being a parent, prior life experiences, and the maturation of being an older adult.

As identity-in-practice is a means of examining who the self is and how the self interacts with the world, it stands to reason that an identity-in-practice lens was the most beneficial way of analyzing the influences on the strategies that nontraditional elementary pre-service teachers used to teach science. Data viewed through the identity-in-practice lens illuminated how each participant was able to form and transform her science teacher identity. By focusing on additional discourses that occurred during science lesson planning and science teaching, the identity-in-practice leans revealed a more panoramic view of each participant. By analyzing and categorizing the commonalities and differences between the two case studies, I was able to elucidate a) how the beliefs and life experiences of nontraditional elementary pre-service teachers were related to their identity development as science teachers, and b) how the teacher preparation program further influenced their identity development.

Participants

Since this investigation had a specific goal, it required a predefined participant pool (Creswell & Clark, 2007; Tashakkori & Teddlie, 1998), which I identified using purposeful sampling. For this study, two participants were selected based on a set of predetermined criteria: nontraditional student, elementary teacher program student, and participating in a student teaching field experience. The participants selected for this study were enrolled in the Mountain View University (pseudonym) Elementary Teacher

Education Program, which prepares its students to teach grades K-6 and is accredited by the National Council for Accreditation of Teacher Education (NCATE).

Prior to any data collection, this study had to be approved by the Virginia Tech Institutional Review Board (IRB) (Appendix A). After receiving IRB approval, I met with each participant separately to discuss the study, answer any questions, and have each sign the informed consent (Appendix B). The pre-service teachers were informed that participation was voluntary, and that their responses and any identifying information would be kept completely confidential through the use of pseudonyms, and that the generated data would not be used for any other purpose. The two participants—Samantha West (pseudonym) and Sarah East (pseudonym)—were informed that they could withdraw from the study and not incur any negative consequences.

Since case studies utilize ethnographic methods, and this study utilized a relatively small number of cases, there was an opportunity to develop a close relationship with the participants (Atkinson & Hammersley, 1998). By focusing on just two students, I was able to spend more quality time observing Samantha and Sarah in the classroom, which facilitated the opportunity to paint a more vibrant picture of the various influences on the strategies they selected to teach science.

Samantha West. Student teacher-participant 1, Samantha, was a 24 year-old nontraditional student who was married and a mother to a 13 month-old daughter. Within a month of graduating from high school, Samantha was married. She and her husband settled into a house within the surrounding area of Mountain View University. After waiting almost a year, Samantha decided that she wanted pursue her dream of being an elementary teacher. However, as a homeowner and the wife of a husband who was employed full-time, Samantha was limited as to where she could attend college. With the assistance of student loans, Samantha was able to attend college full-time. To save money, she initially attended Snow Creek Community College, and worked diligently to complete her AA degree by taking as many courses as possible each semester. To help expedite the graduation process she also took summer courses at Snow Creek, which is where she took her general chemistry and biology courses. During her first interview, Samantha spoke very positively about her hands-on experiences in these courses. Samantha also felt very comfortable at the community college because there were more students who were married. In contrast, once Samantha transferred to Mountain View University, she felt like she under a microscope. Despite being close to the same age as her classmates, Samantha was still considered a nontraditional student since she delayed college enrollment, was married, and was expecting her first child.

Sarah East. Student teacher-participant 2, Sarah East, was an older nontraditional student. At the time of the study, Sarah was 42 years of age, married and had one son. Having spent most of her life in California, Sarah and her family relocated to the Mountain View University area. After getting her son established in middle school, she wanted to reenter the workforce as a teacher. With the support of her husband and son, she enrolled at Mountain View University.

Sarah talked about always wanting to become a teacher. Even as a young child Sarah talked of how she "would take old school books and hold school classes for my friends" (Sarah transcript 1, p. 1, lines 10-11, 4/3/13). Sarah enjoyed helping others and explaining how things worked. As a young child taking dance lesson, Sarah talked of helping other dance students perfect their dance steps. Since her mother operated her own home day care, Sarah had the unique opportunity to work with children on a daily basis. As she watched her mother interact the daycare children, Sarah's "science teacher identity" began to take shape. For Sarah, this interaction with the daycare children and her mother helped to inspire her to be an elementary teacher.

Sarah's formal K-12 education was spent attending a private Catholic school, which she found to be very strict. Sarah easily recalled how her teachers would emphasize language arts; thus, she credited her strong vocabulary to the Catholic school experience. Additionally, while living in a larger urban environment in California, Sarah had access to museums and other educational institutions that provided a rich hands-on science experience, which her Catholic school did not provide. As a result of those varied opportunities, Sarah understood the importance of providing different science experiences as an elementary classroom teacher. Sarah relied on her prior beliefs about science, personal experiences, family, and her teacher preparation program to guide her in selecting strategies to teach science, which ultimately shaped Sarah's identity as a science teacher.

Mountain View University's Teacher Education Program

Mountain View University has been preparing teachers for over 100 years. Since the program requires a major in interdisciplinary studies, students are also prepared for other careers requiring a broad liberal arts background, especially those requiring strong interpersonal skills. The university also offers a licensure program at the graduate level for those who have already earned a baccalaureate in an academic discipline. The School of Teacher Education requires undergraduate students to major in Interdisciplinary Studies in order to obtain a license in either early childhood/early childhood special education, deaf and hard of hearing, special education, general curriculum K-12, elementary or middle school education. Students who complete the Interdisciplinary Studies requirements are eligible for a Virginia Pre-K through 6th grade teaching license.

Full admission to the teacher education program requires passing scores on Praxis I, Praxis II, and VCLA. Pre-service teachers must also complete a speech/language/hearing screening prior to being admitted to the program. Mountain View University requires their undergraduate pre-service teachers to complete a minimum of 52 semester hours of coursework. Of those 52 hours, three are general science courses, including a physical science course designed to include lab activities that can occur in the K-8 science classroom. Program admission also requires participants to document 50 hours of observation and/or experience in an educational setting. As part of Mountain View University's teacher preparation program requirements, students must complete an early field experience known as "blocking" during their penultimate semester while completing coursework. During their last semester, pre-service teachers are required to complete 12 credit hours of student teaching.

It is during the blocking and student teaching field experiences that pre-service teachers work with experienced cooperating classroom teachers and their students. The blocking pre-service teachers work with their university supervisor and cooperating teacher to design a social studies unit. The pre-service teacher then teaches that unit to the students with whom they are working. During student teaching, the pre-service teachers also design a science unit that they then teach to their classroom students. In addition to teaching the science unit, the student teachers also take over the classroom duties of the cooperating teacher. Such field experiences give pre-service teachers opportunities to apply the knowledge gained from both coursework and personal life experiences.

As part of the program, students are expected to use the Universal Design for Learning (UDL) approach when developing and presenting their lessons. UDL requires that teachers shift away from the idea that teaching and learning should be identical for every learner. The UDL model states that the teacher and the curriculum should be flexible enough to accommodate diverse student needs. Today's classrooms are more culturally and ethnically diverse, as well as have learners with a wide range of abilities. The UDL model encourages classroom teachers to avoid marginalizing any student, but rather encourages them to provide a learning environment that embraces all learners.

The Mountain View teacher preparation program provides instruction and support to pre-service teachers so that they are able to conduct classroom instruction based on representation, expression, and engagement. Pre-service teachers learn that concepts need to be presented to classroom students in multiple ways. Lesson differentiation gives classroom students more options for learning new information. Representation of content may include reading information as text, but it should also include varied representations of content in the form of videos, podcasts, slideshows, etc. UDL methods also stress that pre-service teachers must include a variety of options for students to express their knowledge. In short, it is essential that pre-service teachers engage their students in different ways to maximize their individual strengths and abilities.

Data Collection

Understanding the beliefs of each participant and their influences on their development as elementary science teachers relied on collecting rich qualitative data.

Given that qualitative research "fundamentally depends on watching people in their own territory and interacting with them in their own language, and on their own terms" (Kirk & Miller, 1986, p. 9), interviews and observations served as the primary source of data. Thus, the case study approach used in this study illuminated the individual values, dispositions, and practices of nontraditional students enrolled in an elementary teacher training program.

Individual teacher interviews. I conducted a total of twelve individual, semi-structured interviews with both Samantha and Sarah: two 45-minute interviews that focused on the two research questions, five pre-classroom observation interviews, and five post-classroom observation interviews. The pre-classroom and post-classroom interviews were designed to understand the purpose of the science lesson, the participants' reflections relating to the science lesson, and the influences affecting the design of the science lesson. The first 45-minute semi-structured interview, which included nine questions, occurred at the beginning of the project and focused on the women's beliefs relating to science teaching (see Table 1).

Table 1. Interview One Questions

Focus on Research Question 1:
• ***How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?***
1. What do you think of when someone says "science"?
2. Describe your motivations for becoming an elementary teacher, including influential individuals.
3. Describe any previous experiences you had as a child relating to science.
4. Describe your elementary school experiences.
5. Describe the science classes that you had in high school.
6. Describe the science classes that you had in college.
7. What aspects of learning science do you find enjoyable and what aspects do you find least enjoyable?
8. How do you think children best learn science?
9. What do you think will be some challenges to teaching science in the elementary school science?
10. Tell me about your elementary science teacher preparation as it relates to science instruction.

The second 45-minute interview, which occurred after the fifth classroom observation, focused more on how each participant's teacher preparation program influenced her development as an elementary science teacher. The nine questions in this interview (see Table 2) dealt with issues such as courses, their university supervisor and cooperating teacher, and classroom students. As part of the second interview, the questions helped to identify other influences that affected their development as elementary science teachers such as family, children, and life experiences.

The interviews occurred in a private location and at a time that was conducive to the participant's schedule. Throughout every interview, I endeavored to promote a friendly atmosphere by utilizing a conversational interview style—thus avoiding having the interviews "sound like questioning" (Terkel, 2006, p. 126). Since the questions were open-ended, the participants were able to respond with any information that was meaningful for them. Later, each participant was given a transcribed copy of their interview to review and make comments.

Table 2. Interview Two Questions

Focus on Research Question 2:
• ***How do teacher preparation programs influence the identity development of nontraditional students as science teachers?***
1. In what ways do you feel that your teacher preparation program influenced your views about science? 2. In what ways do you feel that your teacher preparation program influenced your choice of science teaching methods used in the classroom? 3. In what ways did your cooperating teacher influence your choice of science teaching methods? 4. In what ways did your university supervisor influence your choice of science teaching methods? 5. In what ways did your students influence your choice of science teaching methods? 6. In what ways did your students with special needs influence your choice of science teaching methods? 7. In what ways did being a nontraditional student influence your choices of science teaching methods? 8. Tell me about other influences that affected your development as an elementary science teacher. 9. Talk about your teacher preparation experience as a nontraditional student.

Classroom science teaching observations. Since this study incorporated an identity-in-practice lens to view the data, it was important to observe the participants teaching science in their classroom. By observing Samantha and Sarah teaching science, I was better equipped to determine how their beliefs correlated to their actions. Again, classroom observations were scheduled at the convenience of each teacher—and these occurred from February 2013 until April 2013. As a participant-observer, I first established a rapport by talking with the participants prior to visiting their classroom. I recorded data throughout each classroom observation; after the fifth classroom observation I then consolidated the information gathered (Howell, 1972). It is important to note that by conducting classroom observations I was at times a participant in the classroom. As such, my presence did not go unnoticed by the classroom students and cooperating teacher. With each observation the classroom students were more interactive with me; for example, a second grader asked me how to pronounce a word, and others shared their thoughts about how well their student teacher was doing.

I followed the same protocol during each classroom observation, as detailed in Table 3. Specific codes were used when recording observations.

Table 3. Classroom Science Lesson Observation Protocol

I. Background Information

Date of Observation:	Teacher Name:	School:
Observation Start Time: End Time:	Grade level:	Subject Observed: Science
Type of Class: Traditional (all day) Sections	Number of Team Members: (If sectional)	Title of Lesson:
Observer:	Observation Number:	
Number of students in class: Males: Females:		

II. Contextual Background and Activities

A. Objective of lesson
B. How does the lesson fit in the current context of instruction? (connection to previous or other lessons)
C. Classroom setting (space, seating arrangements)
D. Any relevant details about the time, day, students, or teacher. (events prior to lesson)

III. Detailed Log of the Classroom Observation

Elapse Time	Observation Notes
Begin Time:	Methods Used
End time:	

I also noted any interactions between the teacher and the students during each classroom observation, and wrote direct quotes or general conversations that occurred during classroom observations. During each observation, I noted the length of time and type of activity. A sample log of one classroom observation is provided in Table 4.

Table 4. Sample Log of the Classroom Observation for Sarah

Elapse Time	**Observation Notes**
Begin Time:	*Methods Used*
1:35 PM	Vocabulary words on board (on cards). Talks about new way of taking notes (Booklet). Passed out booklet and student wrote names.
1:38 PM	Complete chart since they were starting a new SOL. Each table filled out a sticky with what they knew about energy. Gave 2 min.
1:40 PM	Reminds students of time.
1:44 PM	One speaker stands from each table to share what their group wrote. Then places the sticky on the bulletin board.
1:50 PM	Talked about pretest for tomorrow. Gave students words to energy song and then listened to song about energy. (Twice-after student request) (Students were quite during song and attentive.)

Classroom observation interviews. In addition to observing the participants from February 2013 to April 2013, I also conducted pre- and post-classroom observation interviews. The pre-classroom observation questions examined how the participants designed their science lessons and what influenced their lesson design (see Table 5). The post-classroom observation questions gave the participants an opportunity to discuss the success of the science lesson and suggest any adjustments that they would make.

Table 5. Pre-and Post-Classroom Observation Interview Protocol

Pre-Classroom Observation Interview Protocol

Questions to be asked before each science lesson observation:

1. What did you consider in designing this lesson?
2. Tell me about the methods you plan on using to teach this science lesson?
3. How did your teacher preparation program influence the design of this lesson?
4. Describe other influences that affected the selection and design of this lesson?

Post-Classroom Science Lesson Observation Interview Protocol

Questions to be asked after each science lesson observation:

1. Describe your thoughts of the success of the science lesson after being taught.
2. Describe your how your students responded to the science lesson.
3. What did this lesson tell you about how your students learn science?
4. Tell me about any adjustments that you made during the science lesson and what influenced you to make these adjustments during the presentation your lesson.
5. Tell me about any adjustments that you will make to this science lesson in the future and what influenced you to consider these adjustments.

Classroom documents. A variety of classroom documents related to the science lessons were collected from each participant as evidence to support the study. The documents, which included lesson plans and worksheets, were used as evidence to understand how the participants planned their science activities, as well as to identify the strategies used to assist student learning in science. As noted by Krathwohl (1998), using different data sources strengthens a study. In this study, the data obtained from the participant artifacts contributed to a triangulation process. In summary, the science lesson artifacts—coupled with the two 45-minute interviews, the five pre-classroom observation interviews, the five classroom observations, and the five post-classroom observation interviews—helped to paint a detailed picture of what influenced each participant as a developing elementary science teacher.

Main Study Timeline

Once the two participants were identified and agreed to take part in this investigation, the main study began during January 2013 and lasted until May 2013. By the end of February 2013, the first 45-minute interview was conducted and transcribed. The second 45-minute interview was held and transcribed in early May. Each participant began student teaching in January 2013. (See Table 6 for sequential details.)

Table 6: Timeline for Study

Data	Teacher Participant 1	Teacher Participant 2
Interview 1	February 2013	February 2013
Interview 2	April 2013	April 2013
Science Teaching Observation	February 2013-April 2013	February 2013-April 2013
Classroom Documents	January 2013-April 2013	January 2013-April 2013

Analysis of Data

Depending on the study, data analysis can encompass a number of steps. For this study, triangulation of data was used in order to a) confirm similarities and differences in each participant's case study, and b) to check and establish the validity of findings by looking for confirmation from other sources of data. To reiterate, the primary data sources used for this study were the two 45-minute participant interviews, pre-classroom science observation interviews, post-classroom science observation interviews, and five classroom science observations. All of the classroom artifacts were used to strengthen the primary data sources.

I also assigned concepts or categories that aligned with the research questions, which were gleaned from a line-by-line analysis of the interviews (Strauss & Corbin, 1998), as shown in Table 7. Subcategories were used to further examine the when, where, why, how, and who as it related to the categories (Strauss & Corbin). This process of developing subcategories, which is known as axial coding, enables the observer to look at relationships within a particular category or between categories. The use of axial coding facilitated my understanding of how the major categories related to the subcategories at both the property and dimension levels. A property refers to either a general or specific characteristic of a given category. Dimension is a means of locating the property on a continuum relating to the time the event occurred. Once the major categories are identified, a researcher can then examine how they are connected in order to develop themes.

Table 7. Participant Codes

Research Question	Category	Code	Data	Subcategory	Theme
1	Role of Family	RF	Interview	1. Family members 2. Family support 3. Influence of children	Children influence participant's approach to teaching.
1	Beliefs about Science Teaching	BST	Interview	1. Content knowledge 2. Types of instruction 3. Types of activities 4. Science confidence	Science lessons need to be hands-on.
1, 2	Teaching Science in Classroom	TSC	Interview Classroom Observation	1. Daily science routines 2. Type of lesson plans 3. Activities selected	Science lessons are interactive.
1, 2	Teacher Identities	TI	Interview Classroom Observation	1. Daily routines 2. Structured science activities 3. Dress 4. Perceived by others	Participant feels prepared to teach science.
1	Non teacher Identities	NI	Interview	1. Perception of self 2. Organization of task 3. Perceived by others	Struggles with guilt due to lack of time spent with family.
1, 2	Relationships with others	RO	Interview Classroom Observation	1. Family members 2. Colleagues: Student teaching 3. Cooperating teacher 4. Principal 5. Faculty/staff at school 6. Classroom students	Has a positive relationship with cooperating teacher. Has good rapport with students.
2	Discourses of Classroom Teaching	DCT	Interview Classroom Observation	1. Daily routines to provide structure and ownership 2. Increase student knowledge of science content 3. Classroom management during science 4. Organize science activities and materials. 5. Science resources for students in classroom	Participants find confidence in teaching by being organized. Participant meeting needs of students challenging.
2	Discourses of Teachers	DT	Interview Classroom Observation	1. Creative in Planning 2. Professional mannerisms: on time and organized 3. Possess content knowledge	Cooperating teacher and university supervisor provides support. Teacher preparation program provided knowledge to use a variety of strategies.

Once the individual categories and themes were identified, I performed cross-case analysis (Miles & Huberman, 1994). Through cross-case analysis, the researcher is able to develop "a general explanation that fits each of the individual cases, even though the cases vary in their details" (Yin, 1994, p. 112). As shown in Table 8, I organized direct quotes and summary phrases in table form, which enabled me to identify similar categories, make comparisons, and identify themes that emerged across the two nontraditional pre-service teachers' case studies.

Table 8. Summary Phrases and Direct Quotes

Participant One (Samantha)	Source	Participant Two (Sarah)	Source
Summary phrases and direct quotes	1. Interview One 2. Interview Two 3. Classroom Pre-Observation 4. Classroom Post Observation	Summary phrases and direct quotes	1. Interview One 2. Interview Two 3. Classroom Pre-Observation 4. Classroom Post Observation

Identifying categories and themes of interest facilitated the ability to propose a logical and consistent explanation for the observed phenomenon—namely, how nontraditional elementary teacher program students negotiated their teaching of science in the classroom.

Qualitative studies such as this one rely heavily on comparison and interpretation. The comparability of data relates to the completeness of descriptions, which refers to the participants, settings, and data from the research. The researcher must be clear in how the findings came about by being explicit in the techniques and theoretical stance (Schofield, 1990). After completing each participant observation, a narrative description was written that identified themes that emerged from the research questions. The narrative included questions that arose and how each question could be addressed.

Validity

As patterns emerged from the data collected, it was important to establish validity, which in any study simply refers to whether the findings of a study are true (Johnson, 1997). In other words a valid study indicates that it accurately reflects the situation and can be supported by the evidence. Patton (2002) described the various strategies that a researcher can use to promote validity. For instance, a qualitative researcher can use triangulation to check and establish validity by analyzing the research question from multiple perspectives. Some of the strategies incorporated to establish validity in this study were using field notes, direct quotes from the participants, peer review, reflexivity, and triangulation of the data.

As confirmed by the scholarly literature, teacher beliefs and strategies used in teaching science tend to be formed by prior experiences. This knowledge was utilized when examining the results from interviews, classroom observations and lesson plans, and then applied in strengthening the validity of the findings. During the study, the participants were given the freedom to be creative as they developed their lesson plans and managed their classroom.

Trustworthiness

I began this study with the understanding that there are potential risks to trustworthiness. One risk was my personal bias about how science should be taught. As stated by Marshall and Rossman (1999), the greatest challenge in a qualitative study using case studies is to eliminate any personal bias from the study's design and subsequent findings. Thus, a researcher must be aware of such tendencies throughout a study, but especially when analyzing data sources. To avoid this potential pitfall, I wrote memos after each interview and classroom science teaching observation as a means of documenting my thoughts and views. Moreover, I employed the same ethics to which I adhere as a teacher, graduate student, and researcher. Some of these ethical values include acknowledging the extent to which an action produces benefits to society, avoiding purposefully deceiving others, and at all times following all protocol set forth by the Institutional Review Board.

Another potential risk was the pre-existing relationship of the researcher to the one of the participants. Specifically, I am an instructor for one of the participants in a physical science course designed for the teacher preparation program students. During the course of this study, however, this individual was no longer under my instructional purview. Nonetheless, this pre-existing relationship did afford some advantages in knowing the participant on a more personal level, thus resulting in richer data. It is important to note, however, that this relationship may prompt questions about the data collected. Additionally, there was some concern relating to the difficulty of being more (or less) critical of that participant's teaching style or science lesson selection. I was also aware of the possibility that this woman might feel that she had to alter her teaching style or use different lessons in my presence. Another concern that arose from being a former instructor of one participant was that she might ask for advice on teaching or the optimal science activities that should be used in the classroom. As a result of these concerns, I was always conscious throughout our conversations and interactions not to sway the thinking of the participant. To help with enhancing the trustworthiness of this study, I kept field notes and memos during the entire duration of the project.

Human Subjects

This research abides by the policies of the Internal Review Board (Appendix A), and the participants will have provided their consent to be part of this study (Appendix B). As the principal investigator of the study and to the best of my ability, it has been determined that no reasonable physical or psychological harm has come to anyone as the result of this research. The participants in this study were not deceived or coerced with leading statements or false information into participating or during any other time during this investigation. They were informed that they could withdraw at any time and for any reason. I kept the resulting study data in the strictest confidence. No information was released that could identify the participants by their responses. To address the concern of confidentiality, the participants were assigned pseudonyms, and the names of all locations were changed. All of the original data collected during the study was stored in a safe location by the researcher.

Stance of Researcher

As a science educator with 24+ years of teaching experience at both grades 6-12 and the college level, I naturally approached this investigation with specific views as to how science should be taught. Being a product of both undergraduate and graduate-level teacher education programs that encouraged inquiry-based thinking, I, in fact, have very definite views on how science should be taught. Inquiry involves a process of questioning the ways knowledge and practice are constructed, evaluated, and used. Like Cochran-Smith and Lytle (2009), I argue that to understand how students learn science, one must first consider the rationale used by classroom science teachers in selecting specific pedagogical strategies.

Believing that learning needs to be interactive and social, I view science teaching through a Vygotskian lens, which for me means that learning occurs beyond the elementary science classroom. My Vygotskian views are also applicable to how science teacher preparation should be conducted. With social participation, knowledge is transferred from one individual to another. Linking to Vygotsky's assertion that learning is social, Wenger (1990) described how the development of a teacher is an identity-in-practice. Similarly, I believe that life experiences are valuable. Thus, the relationship that exists between a pre-service teacher and a cooperating teacher is critical in understanding how the former develops his or her identity.

Summary of Methodology

This study examined how nontraditional pre-service teachers negotiated the teaching of elementary science. By considering the participants' prior beliefs about science and what influences the strategies selected to present science concepts to their students, I was be able to understand how each participant negotiated teaching elementary science. Case studies were conducted on two nontraditional pre-service teachers to (1) gain an in-depth view of each participant's initial beliefs about science and elementary science teaching, (2) determine how each participant was influenced by her teacher preparation program in science, and (3) identify what other influences affected their development as elementary science teachers. Multiple data sources were collected and analyzed, including teacher interviews, field notes, lesson plans, and classroom observations—all with the goal of producing a rich description of participants' views and classroom teaching strategies.

Findings from this study can provide insights into the beliefs of nontraditional elementary teacher program students relating to science and the teaching of science. It is hoped that this investigation will provide a better understanding of the influences on science teaching with a selected cohort—namely, nontraditional pre-service teachers—as well as the strategies they use to teach science in the elementary classroom.

Chapter Four: Results and Findings for Samantha

This chapter contains a brief introduction for the two case studies of the nontraditional students who took part in this study, followed by a case study of student teacher-participant Samantha West. A second case study about student teacher-participant Sarah East is detailed in Chapter 5.

This study investigated the influences that affected the development of nontraditional pre-service teachers as elementary science teachers. The goal was to determine how each participant's beliefs about science teaching and life experiences related to their identity development as science teachers. A secondary goal was to examine how the participant's teacher preparation program influenced their identity development as a science teacher. The teacher preparation program influences include the science education courses taken, the student teaching cohorts, university supervisors, cooperating teachers, students, and classroom experiences. Additionally, a look at specific field experience in schools provides supporting data on the influences related to classroom instruction and students. By analyzing each participant's beliefs about teaching of science, life experiences, and teacher preparation program experiences, this study was designed to identify how nontraditional student teachers negotiate the teaching of science in elementary schools.

The results are organized as case studies based on the two research questions that framed this study:

1. *How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?*

2. *How do teacher preparation programs influence the identity development of nontraditional students as science teachers?*

The questions are presented separately; each is followed by a complete description of each participant's supporting data. Vignettes are also included to assist in understanding the context of how the participant's identity developed as a science teacher. A summary analysis of the research questions is also provided.

Case Study One: Samantha West

Research Question 1. How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?

This section focuses on Research Question 1, which examines the beliefs and life experiences of participant Samantha West as they relate to science and science pedagogy. Samantha's views about science teaching, as well as the influences of her life experiences and family, provide insights into how her identity as a science teacher developed. By constructing how Samantha developed as a science teacher, I was able to use this information as a framework for interpreting the role that beliefs and life experiences may play in the development of nontraditional students as elementary science teachers.

Beliefs and Life Experiences

Samantha entered her teacher preparation program with established beliefs relating to science teaching. Surprisingly, Samantha could not recall any of her elementary classroom science experiences, but she was quick to recall not participating in a "science fair or anything like that" (Samantha transcript 1, p. 2, line 25, 2/22/13). Despite the lack of science experiments at the K-8 level, Samantha still believed that science lessons should include experiments. Samantha expressed her belief that science should be interactive and that students need to be given the time to learn important science concepts. As Samantha designed her science lessons, she incorporated demonstrations, activities, and other pedagogical practices that would invite her students to become more involved in their science learning. Samantha believed that kinesthetic experiences make science more enjoyable and more applicable to the real world.

Even though she was a younger nontraditional student, Samantha entered Mountain View University with a variety of life experiences. One experience that appeared to impact her identity as a teacher was the time she spent with her stepmother. When asked about who influenced her decision the most in becoming a teacher, Samantha replied without hesitation that it was her stepmother. Samantha went on to say, "Well, my stepmom was a teacher. I always played school. I just grew up always wanting to be a teacher" (Samantha transcript, p. 1, lines 8-9, 2/22/13). She vividly recalled how her stepmother would take the time to help her with her homework, such as explaining simple genetics problems.

Samantha's beliefs about teaching science were also influenced by her high school experiences. When her family moved to another state, Samantha found herself facing numerous challenges. One life-changing experience that shaped her identity as a teacher was being in a new school. As she sat in her new chemistry class, Samantha realized that she had not covered the material being presented; as a result, she quickly became frustrated and overwhelmed. Samantha talked candidly about her chemistry experience:

> Actually, I failed chemistry my 10th grade year. What had happened, I was living in Arkansas and I was taking chemistry and making A's. When I moved back to Texas it was mid-year and they were already way ahead of us. It was really hard to catch up. I feel like once you miss something you can't catch up. It was really difficult. I retook it the next year and I made an A. (Samantha transcript 1, p. 2, lines 35-42, 2/22/13)

Samantha was focused and determined to be successful in school. Stemming from her high school chemistry experience, Samantha now understood that students come to the classroom with different prior knowledge and skill sets. Samantha believed that if her students did not understand key science concepts or missed material then they would be cognitively behind, thus leading to feelings of frustration. Relying on her past school experiences, Samantha found it difficult to teach new science concepts when she knew that some of her students were not understanding the material. Samantha designed her lessons to include a variety of activities so that she could meet the needs of each learner.

Based on Samantha's responses, her beliefs about teaching science seem to be influenced by her past life experiences, including the time she spent with her stepmother, time spent as a student, and her ability to adapt to different learning environments. Even though science was not her favorite subject, Samantha understood the value in teaching it. Samantha's identity as a science teacher was deeply rooted in her prior school experiences and her personal learning style. However, Samantha still held tight to the belief that teachers should present science concepts in a manner conducive to the independent learning needs of every student. Based on Samantha's interviews, it was evident that Samantha's life experiences played a key role in her identity development as a science teacher. Samantha was able to use her life experiences to shape her identity as a science teacher, which featured the use of more kinesthetic activities and her conscious effort to understand the backgrounds of her students.

Family

As Samantha discussed the influences on her development as a science teacher, she spoke about her young daughter. Samantha described how having a young child and maintaining her house influenced her as a science teacher:

> I think about safety more. I do not like for things to be messy at home so I thought of how to make things neater in the classroom. Trying to take less time and be cleaner. By having Chloe [pseudonym] at home, I think about safety. (Samantha transcript 2, p. 3, lines 53-55, 5/10/13)

As a young mother to a toddler, Samantha was very aware of safety. At home Samantha was constantly checking and making sure that things were out of harms way. During classroom instruction, I observed that Samantha was highly aware of things not in their proper place. As she walked around the room, she would pick up crayons, pencils, and other materials. To eliminate clutter and distractions, Samantha would have the students place all items away before moving on the next task—and would delay further instruction until they did so.

It is important to note that by having a family, Samantha felt the need to be organized and have her science lessons prepared ahead of time. Since Samantha was student teaching, her time spent with her family was limited. This awareness carried over into her classroom preparation. To expedite the science lessons so that she could include more hands-on activities, Samantha spent time preparing and pre-cutting items for her science lessons. Thus, clean up time was drastically reduced. In anticipation of the time needed for the children to complete her *Fossil Lesson*, Samantha prepackaged all of the items so that she could pass out the items quicker and keep clean-up to a minimum. During her *Fossil Lesson,* Samantha also spent time discussing safety and procedures for cleaning up with her students. Samantha attributed her consistent focus on safety and maintaining an orderly classroom to having a young child at home. (Samantha science lesson observation 2, 2/28/13, fossil lesson)

By being organized, Samantha was able to balance her role as a mother and as a student teacher. Even though her daughter was still relatively young, Samantha's teacher identity was intertwined with her identity of being a mother. Being a nontraditional student with a young child, Samantha was able to access her parental identity as she negotiated science teaching in her elementary classroom. The link between her identity as a parent and as a teacher was evident through observations and when Samantha acknowledged having a more heightened awareness of safety and being more organized with her class instruction.

Influence of Teacher Preparation Program

Research Question 2. *How do teacher preparation programs influence the identity development of nontraditional students as science teachers?*

This section focuses on Research Question 2, which examines how the participant's teacher preparation program influenced her identity development as a science teacher. As a means for understanding what influenced her identity as a science teacher, this section looks specifically at Samantha's science courses, student teaching cohort, university supervisor, cooperating classroom teacher and experiences in the classroom as a student teacher.

Attending Mountain View University

Mountain View University's teacher preparation program is comprised of programs that help to prepare teachers and administrators to work with children from birth through grade 12. As part of their training, pre-service teachers participate in practical field experiences within their fields of study. Mountain View's teacher preparation program offers courses that are taught by faculty members who have expertise and research experience in high-impact teaching strategies, cultural responsiveness, instructional technology, and interdisciplinary teaching.

With her husband working twelve-hour shifts and owning a home, Samantha was limited as to which four-year college she could attend. Mountain View University was the closest option for Samantha, with a round-trip commute of forty minutes every day. As a nontraditional student, Samantha was very nervous about coming to Mountain View since she was married and pregnant. She talked of how her hands swelled, but she would always make sure that she forced her wedding band on her finger so that no one would think that she was an unwed mother.

During her first semester at Mountain View, she took a physical science course and a science methods course. These courses were designed to help pre-service teachers increase their confidence in teaching science, provide science content knowledge, give experiences with hands-on activities, and assist in designing science lessons that meet the needs of diverse learners. Samantha's physical presence in these courses was shortened due to the birth of her daughter. Though she was a young nontraditional student, Samantha was mature enough to realize that by not being present for instruction she missed information that could be beneficial to her science lesson planning.

Once Samantha completed her general course work she was ready to begin her "blocking" field experience. Blocking gave Samantha her first opportunity to spend a longer duration in the classroom. Samantha was assigned to work with a kindergarten teacher in a rural school for a semester. Additionally, Samantha was required to take four educational courses during her blocking field experience. Another program requirement was to design a two-week long social studies unit and teach that unit to her classroom students.

Following a successful blocking experience, Samantha began her student teaching experience. She was assigned to work with a second grade teacher. In addition, Samantha was expected to assume full responsibility for teaching the class, as well as designing a two-week long science unit. Samantha was faced with many challenges in trying to help her second grade students. She felt more confident teaching Kindergarten-age students than second grade students. This was evident as Samantha reflected on her blocking experience during her first interview when asked about the challenges she faced while student teaching. Samantha stated: "It is a lot more challenging than I expected. I was in Kindergarten last semester. I got through to them just fine" (Samantha transcript 1, p. 6, lines 119-124, 2/22/13). Essentially, Samantha began to question her ability to work with older children. She was taken back by this challenge and struggled with being unable to find success with her second grade students. However, Samantha used this challenge to enrich her development as a science teacher and to work more closely with her cooperating teacher and university supervisor.

Science Methods Course

The purpose of the science methods course was to offer pre-service teachers more concrete experiences for classroom application. In the science methods course students used everyday materials to explore and practice effective science pedagogy. The course devoted time discussing how to apply learning theories to science pedagogy and incorporating national and Virginia Department of Education standards (VDOE) in planning and instruction. Thus, the science methods course sought to empower pre-service teachers in teaching science.

Samantha entered Mountain View with her own beliefs about teaching science. Her science methods course did influence how she assimilated new information relating to teaching and learning. This was apparent as she commented about her physical science and science methods courses: "Well, science is not my best subject. It made me think about making it more active. I have always thought that. In your class [physical science] we did activities" (Samantha transcript 2, p. 1, lines 3-4, 5/10/13). She continued to talk about how her teacher preparation courses and her science courses influenced way of teaching science:

> It definitely made me think about how I teach science. Your class [physical science] made me think about the activities. Dr. K's class was good. I missed the fun stuff because I was out with Amelia, but I heard about all the fun activities. She did more with tests, vocabulary those sorts of things…more how to present the material. (Samantha transcript 2, p. 1, lines 7-10, 5/10/13)

As Samantha worked with the course instructor, she became more confident in using a variety of strategies to present science concepts. Samantha's science methods course was instrumental in giving her more specialized tools so that she could teach science more effectively, thus nurturing her identity as a science teacher. Samantha also expressed how her teacher education program helped her prepare for the Universal Design for Learning (UDL). As she developed her lessons, the UDL gave her the tools to think about how to reach all of her learners—rather than just teach the way she learned best. For Samantha, the materials presented in her science methods course caused her to consider other strategies. Samantha discovered that the way she learned best was not necessarily how others learned science. The science methods course and the experiences from working in the classroom helped to mold Samantha's identity as a science teacher. Her teacher identity was fashioned, refashioned, and confronted as she adapted to different educational perspectives, such as those presented by her teacher education program, cooperating school, cooperating teacher and her classroom students.

Student Teaching Cohort

Pre-service teachers are divided up into cohorts once they are admitted to Mountain View's teacher education program. Cohort members work together during their blocking and student teaching placement. The primary objective of student teaching is to provide the opportunity for acquiring and demonstrating instructional competence. The cohort was also designed to provide a means of support, especially in designing lessons.

Samantha was fortunate to be assigned to a school that was only five minutes away from her house. Samantha's cohort members were all traditional student teachers; she was the only student teacher that was married and had a child. Due to her parental responsibilities, Samantha did not socialize with her cohort members outside the school setting. However, Samantha found comfort in having other student teachers to talk with when it came to designing lessons and sharing classroom experiences. Samantha talked about how her cohort members would find great science lessons, but would not think about the amount of instructional time needed for clean up. Samantha commented:

> I noticed that the other girls in my cohort would take longer to clean up after an activity. They didn't think about the clean up time before an activity. She [her daughter] is definitely the reason that I think about safety when doing activities in the classroom. (Samantha transcript 2, p. 3, lines 57-59, 5/10/13)

As a mother, thinking about safety came naturally to Samantha. She found that by having a young child she understood the importance of being more efficient with her science instructional time. As a team, the cohort members worked together to develop science lessons and to share science worksheets. Samantha appreciated this aspect of working in a cohort, but she spent extra time making adjustments to the lessons and worksheets to meet academic challenges of her students, especially those reading below grade level. Knowing that her cohort members did not have students who were reading below grade level Samantha become very frustrated by having to constantly make changes to all of her lessons.

As a nontraditional student with a family, Samantha did not have time to socialize beyond school hours with her cohorts. She talked about how her cohort members had the freedom to work on their lessons as soon as they arrived home. In contrast, when Samantha arrived home she would spend the early part of her evening taking care of her daughter and other household responsibilities such as laundry, cooking and cleaning. It was not until her daughter was asleep that Samantha could turn her focus back to lesson planning and schoolwork. Despite the frustrations associated with spending extra time altering her classroom lessons, Samantha appreciated the collaboration with her cohort members as she saw the value of working together and sharing ideas.

University Supervisor

Student teaching gave Samantha an opportunity to put the theory gained from her teacher preparation program into practice, which was augmented by her mentoring relationships with her two university supervisors and her cooperating teacher. Because they were parents themselves, Samantha was able relate well with them. Like Samantha, they were efficient with their time at school so that they would have more time at home to spend with their families. Moreover, Samantha's supervisor and cooperating teacher understood when she needed to miss class or reschedule appointments when her daughter was sick.

Samantha was assigned to work with two university supervisors. She identified with one of her supervisors more than the other because she found his advice more useful and pertinent to her classroom instruction. Her main university supervisor was an advocate of using books to introduce content to students. When he met with Samantha and her cohort members, he made suggestions as to how science instructional strategies could be linked to reading; in fact, he would often bring children's literature books to share with them. The reading suggestions appealed to Samantha since many of her students struggled with reading. What was so appealing to Samantha was that she could readily incorporate his ideas and suggested books into her science lessons. The mentoring relationship between Samantha and her university supervisor gave her access to classroom-tested strategies that helped her be more successful in presenting science content.

Cooperating Teacher

During student teaching, Samantha was assigned to work with a "self-contained" second grade classroom teacher. As a self-contained class, Samantha was expected to teach all of the core subjects (e.g., English, reading, mathematics, social studies, science). Samantha's cooperating teacher was a former special education teacher who was a reading specialist with over 20 years of teaching experience. During classroom conversations, her cooperating teacher talked about how science was not her favorite subject to teach. She was elated over having Samantha teach science.

At one time the school was an open court school—i.e., there were rooms (for example, the library) not enclosed by four walls. The library was directly across from Samantha's classroom. Student artwork and classwork were attached to the wall outside the classroom door. The classroom was very organized with a classroom library, language arts and math centers, interactive board, and an Elmo projector. On the classroom walls hung math, language arts, social studies and reading posters. Classroom rules were posted on the wall by the interactive board. It is important to note that there were no science posters on any; nor were there any "science centers" for the children to use during center time.

By working with a cooperating teacher with a strong special education background, Samantha was able to learn how to incorporate a variety of reading practices in her science lessons (e.g., guided oral reading, vocabulary instruction). Samantha's cooperating teacher was also very aware of her students' individual needs, both academically and personally. Granted, although science was not her cooperating teacher's favorite subject to teach, she did have a wealth of knowledge when it came to working with students who read below grade level. A strategy that Samantha implemented with success was the interactive notebook. As Samantha commented, "I tried to make it mine. Use some of my own questions. Change it a little bit. The children seemed to like the notebooks and making the folders" (Samantha transcript 2, p. 1, lines 15-16, 5/10/13). During her science lessons, Samantha would relate the science concept to the students' own lives.

Due to her inexperience with working with students who read below grade level, Samantha struggled with finding pedagogies that interested them. At the beginning of her student teaching experience, Samantha noticed that the children would become frustrated when they could not keep up in taking notes. She also noticed that the students had difficulty staying focused during her science lessons. At the beginning, Samantha relied more on her cooperating teacher to help her restructure her science lessons. In fact, Samantha found it necessary to have her cooperating teacher work with a few of the students independently. Samantha remarked, "I had her [cooperating teacher] to come and take a few kids back. They are not paying attention and are not with me" (Samantha transcript 1, p. 5, lines 99-100, 2/22/13). Samantha struggled with the students who could not keep up with her science instruction. However, Samantha's cooperating teacher worked patiently with her to implement strategies that would help her lower-achieving students stay interested in science.

It was through daily conversations and observations that Samantha's cooperating teacher was able to help her refine and adjust her science teaching strategies. The student teaching experience afforded Samantha the time to glean advice and assistance from a veteran classroom teacher, thus reshaping her teacher identity. It was the identity-in-practice that provided Samantha with insights as to which strategies would be best for presenting difficult science concepts to her students, especially the students were reading below grade level.

Content knowledge and pedagogical knowledge are only part of being a teacher. Samantha was able to connect her prior knowledge and her life experiences to practice as a student teacher. Working closely with her cooperating teacher, Samantha acquired more specialized teaching tools to connect her science lessons to the needs of her students. Samantha gained a greater appreciation for her cooperating teacher with respect to how time consuming it can be when designing science lessons for students who are reading below grade level. Samantha was inspired by the love her cooperating teacher had for her students and her ability to motivate them to become confident readers. The hours of collaboration with her cooperating teacher enriched Samantha's identity to make her a more versatile science teacher. Since knowledge is a social construct, the identity-in-practice facilitated through apprenticeships supplied Samantha with the skills necessary to reshape her science identity. Through her student teacher-teacher apprenticeship, Samantha was able to learn how to blend her life experiences with her teacher preparation program experiences to create science lessons that were more dynamic.

Experiences in the Classroom

Samantha's interactions with her daughter gave her greater insights such as how young children learn, how to maintain an inviting, but disciplined classroom environment, and how to more effectively involve parents in their child's education. For example, by being a mother to a young child, Samantha was more aware of safety. She also understood the importance of keeping her explanations simplistic and keeping things organized to promote efficiency. However, Samantha was constantly perplexed by the challenges she faced in the classroom, especially presenting science concepts to her students. She comments:

> As you know, 9 of the 15 students had difficulty in reading. I thought about this a lot in planning my lessons. They had difficulty in reading so I would try to read the directions more to them. I used more fill-in-the-blank. I also made sure that I wrote everything out and had it up on the board for them to see. I tried to do different things and get them up when I could. They did not have a long attention span. (Samantha transcript 2, p. 2, lines 31-35, 5/10/13)

In short, she realized that she could not present the content in just one way if she was going to help all of her student learn science concepts. Samantha relied heavily upon the UDL knowledge gained from her teacher preparation program course work and the advice of her cooperating teacher. UDL requires teachers to know their students' strengths and weaknesses. Samantha relied more on her students when it came to developing her science lessons. Her students were the reason that she included strategies such as hands-on activities, singing, games, and coral response when it came to teaching science. Drawing upon her teacher preparation course work and her cooperating teacher and cooperating students, Samantha was not afraid to try new strategies—although some were more successful than others. Whether it was successful or not, each science lesson gave Samantha an opportunity to modify her reflective practices so that all of her students could learn.

The strategies Samantha selected to teach science provided insights into the development of her identity as a science teacher. When Samantha developed her second grade science lessons, she reflected on a variety of things—such as her students' interests and their abilities. Samantha also referred back to own her life experiences from being a student and a parent when designing and administrating her science lessons. As a student teacher, Samantha's cooperating teacher also influenced her strategy selection. By analyzing how the participant selected strategies based on instructional pedagogy facilitated an understanding of her development as a science teacher and her rationale for selecting strategies to teach science.

Early into her student teaching Samantha realized that some of her second graders were not as intrinsically motivated, which caused her to revisit her existing beliefs relating to teaching science. Samantha described how she thought students learn science best:

> I think more by hands-on. Like with the students on Monday…the experiment that I did with the thermometer. I just put it in the warm water and they were so excited. They [the students] were this is so nice. And then you know after the experiment they were less interested. Kind of bored with it. But just by having them actually see it. I really try to get them to understand it by seeing it. It really helps a lot…better than explaining it. (Samantha transcript 1, p. 4, lines 66-71, 2/22/13)

Reflecting upon her lack of elementary science experiences and finding hands-on science activities more enjoyable as college student, Samantha believed that hands-on activities are the best way for students to learn science. With the majority of her students reading below grade level, Samantha relied on her past life experiences when selecting strategies to teach science. She thought about what made learning science more enjoyable for her. Samantha incorporated more hands-on activities to assist in explaining difficult science concepts to all of her students, but in particular to her students that were reading below grade level.

With only about 40 minutes to teach science, Samantha was stressed by having to cover so much science material. This placed limits on both the length of her lesson and the types of strategies that could be incorporated. Relying on her past experiences and knowing that some of the students were more kinesthetic learners like her, Samantha included demonstrations and simple experiments. Samantha described her rationale for using a variety of instructional pedagogies:

> They had difficulty in reading so I would try to read the directions more to them. I used more fill in the blank. I also made sure that I wrote everything out and had it up on the board for them to see. I tried to do different things and get them up when I could. They did not have a long attention span. (Samantha transcript 2, p. 2, lines 32-35, 5/10/13)

During the second interview, it became obvious that Samantha understood why the UDL was a valuable tool for teaching science. With her own beliefs about how science should be taught and her experiences as a mother, the UDL forced Samantha to evaluate the learning needs of all her students. As Samantha learned more about her students, she saw the value in including a variety of activities when designing her science lessons. It was evident during the classroom observations that Samantha had a strong foundation in pedagogical content knowledge and inquiry-based learning, which was exemplified by her examples, explanations, and demonstrations used in her science lessons. These strategies not only helped her students understand the new material, but also assisted in making connections to their prior knowledge.

As a specific example of her effectiveness, Samantha designed a science lesson that introduced the students to paleontologists and their role in the scientific community. This lesson was a good example of how Samantha merged the guiding principles of the UDL and her beliefs of how science needed to be hands-on. In order to create such a lesson, Samantha had to know her students. Through her apprenticeship relationship with her cooperating teacher and her own desire to know her students, Samantha developed a lesson that incorporated a variety of strategies, but most importantly interactive learning. To help with organization, Samantha gave the students an activity sheet to complete as "pretend paleontologists." This vignette demonstrates how Samantha was able to reshape her science teacher identity by interacting with her students during the teaching of the science lesson.

Digging for a fossil: vignette. This was the final lesson in the fossil unit. Samantha started the lesson with a science review of material covered relating to fossils. She asked questions (e.g., What is a fossil?; What is the name of Virginia's state fossil?) and had students repeat answers as a group. After about four minutes of questioning and discussing the role that paleontologists play as scientists, two students passed out dry erase boards and markers to play a review game of "last man standing." Samantha explained that they were going to be paleontologists. Samantha went over her expectations and directions prior to starting the hands-on activity. Then, Samantha revealed multiple-choice questions on the Elmo projector screen one at a time. She read the entire question and the children would write the letter of what they thought was the correct answer. She asked the students again about paleontologists and what do they do. After ten minutes, the students began the "Fossil Dig" activity. Each child was given a baggie with their fossil digging materials inside and an activity sheet. Students were very excited and chatty, which prompted Samantha to call for them to pay attention. The children worked in pairs and helped each other identify the animal cracker fossil that hidden was in their treat rock.

As Samantha reflected on her Fossil Dig activity, it was evident that she equated good teaching to presenting information in a way that cultivates student curiosity. When faced with challenges in teaching science (e.g., the lower reading level of her students), Samantha sought out a variety of strategies including evidence-based practices presented by her teacher preparation program. Samantha attempted to have her students apply the knowledge that they gained during their hands-on activities by completing an activity sheet. Samantha found that the majority of her students struggled when identifying their fossil animal cracker. The lower-level readers also needed additional assistance in completing the activity sheet. As a result of their insecurity, the students asked either Samantha or another student beside them how they should answer the questions on their fossil activity sheet. This was frustrating for Samantha, but she was not surprised. As she reflected on the lesson, she spoke of how pictures of the fossils would have helped the students in identifying the fossils.

Summary of instructional strategies. The instructional strategies I observed Samantha using to teach science were based on five classroom observations of approximately 40 minutes in length. It is important to note that science and social studies were taught on an alternating three-week schedule. The students would receive science instruction for three weeks and then social studies would be taught for three weeks.
As part of being an effective teacher, Samantha drew from a collection of instructional strategies and models, as shown in Table 9. She was able to adjust the selected strategies to meet the needs of her students and the specific learning objective. For Samantha, there were many occasions for which the most effective way to teach a concept was to use expository teaching or teacher-directed learning. Samantha utilized this strategy when the students needed to learn specific kinds of knowledge such as what a magnet is or the purpose of a compass. During her *magnet lesson* she described what a magnet was by using a closed worksheet. The students were given time to fill in the missing notes while she wrote them on the board for students to see (Samantha classroom observation 1, 2/5/2013, magnet lesson).

When Samantha wanted her students to learn for understanding she would implement experiments, problem solving, collaboration, and manipulation of physical objects. During the *temperature lesson*, the students first learned how to correctly read a thermometer on paper. After practicing on paper, the students were given the opportunity to read an actual thermometer to determine the temperature of water in a container. (Samantha classroom observation 3, 2/22/2013, temperature lesson)

Samantha included inquiry learning, cooperative learning, concept attainment, and class discussions as her selected strategies. Her goal was the formation

Table 9: Science Instructional Strategies Used by Samantha to Teach Science

Categories of Instructional Strategies	Specific Strategy	Classroom Observation Evidence
Direct Instruction	1. Lecture	Magnets, Butterfly cycle
	2. Explicit Teaching	All
	3. Drill and Practice	Temperature, Butterfly cycle
	4. Compare and Contrast	Temperature, Butterfly cycle
	5. Didactic Questions	All
	6. Demonstrations	Temperature
	7. Guided and Share (Reading, listening, viewing, thinking)	Plants, Magnet
Interactive Instruction	1. Role Playing	Plants, Butterfly Cycle
	2. Peer Partner Learning	Fossil
	3. Discussion	Magnet, Butterfly Cycle, Fossil
	4. Laboratory Groups	Fossil
	5. Think, Pair, Share	Butterfly Cycle
Indirect Learning	1. Reading for Meaning	Magnet, Butterfly Cycle
	2. Inquiry	Temperature, Fossil
	3. Reflective Discussion	Butterfly Cycle, Temperature
	4. Concept Formation	All
	5. Concept Attainment	All
	6. Cloze Procedure	Magnets
Independent Study	1. Learning Activity Packages	All
	2. Homework	All-Study for Test
	3. Assigned Questions	Temperature, Fossil
Experiential Instruction	1. Conducting Experiments	Fossil
	2. Games	Magnets, Butterfly Cycle, Fossil
Table Note: (Observation Number-Title of Lesson) 1- Magnet 2- Temperature 3- Plants 4- Fossils 5- Butterfly Cycle		

of cognitive structures including concepts, generalizations, dispositions and understanding rather than simple attainment of specific facts or mastery of discrete skills. After spending time explaining the definition of a fossil and who looks for fossils, Samantha gave the students the opportunity to be a paleontologist and dig for animal cracker "fossils" hidden within a rice crispy treat. (Samantha classroom observation 4, 2/28/2013, being a paleontologist) In this way she hoped that by role playing the students would better understand what is was like to conduct a fossil dig and how fossils are identified. As indicated by her second interview, Samantha was aware that inquiry-based learning allows students—regardless of educational level—to participate in a more rich learning experience and allows the students to build upon prior knowledge.

Through class discussions, cooperative learning and peer mediated instruction, the students were able to listen to their classmates explain how they were able to process science information (e.g. reading a thermometer). By using multiple instructional strategies, Samantha was able to create an atmosphere in which all of her students felt part of the classroom-learning environment. For example, when Samantha was teaching about the life cycle of the butterfly, she encouraged the students to work together in creating a model of the cycle on paper. Moreover, it was through classroom discussions about temperature that Samantha was able to discover that some of her students could not count by 5's. (Samantha classroom observation, 2/22/2013, temperature lesson)

By having an understanding of the UDL in lesson development and including a variety of strategies used to teach science, Samantha demonstrated that she was well aware that teaching was more than telling. Having both the content knowledge and pedagogical knowledge gained from her teacher preparation program, Samantha was able to use the identity-in-practice knowledge gained from her field experience to design and implement science lessons, and then reflect upon their success. It was Samantha's field experience that helped her move towards full membership in teaching profession, thus shaping her teacher identity. With guidance from her cooperating classroom teacher, Samantha was able to connect theory to practice as she assumed full control of the classroom and implemented her science lessons. Since knowledge is a social construct, Samantha's teacher identity was refined due to the feedback and knowledge acquired by her experiences as a student teacher, thus allowing her to grow as a professional.

Samantha portrayed effective science pedagogy by using a variety of strategies that also accommodated the different learning needs of her students. As an effective teacher, Samantha was able to integrate these strategies while meeting given instructional objectives. She was also able to assess the success of each strategy by observing her students and evaluating their success on assignments. Samantha described her rationale for using a variety of instructional pedagogies:

> They had difficulty in reading so I would try to read the directions more to them. I used more fill-in-the-blank. I also made sure that I wrote everything out and had it up on the board for them to see. I tried to do different things and get them up when I could. They did not have a long attention span. (Samantha transcript 2, p. 2, lines 32-35, 5/10/13)

Samantha demonstrated her understanding of pedagogical content knowledge and inquiry-based learning as illustrated by her examples, explanations and demonstrations used in her science lessons—all of which she designed to help her students understand new material and to assist them connect with prior knowledge.

Working with her university supervisor, cooperating classroom teacher and the classroom students, Samantha reaffirmed her belief that teaching is more than telling. Samantha used the identity-in-practice knowledge gained from her teacher preparation program and field experience to design levels of learning appropriate science lessons and reflect upon their success. With feedback provided by both her university supervisor and cooperating teacher, Samantha enhanced her ability to reflect upon her teaching and the strategies used to teach science. Since knowledge is a social construct, Samantha's teacher identity was refined as a result of the feedback and knowledge acquired from her teacher preparation program.

Case Study One Summary

Samantha entered her teacher preparation program with prior beliefs relating to the teaching of science. Her beliefs about how science should be taught stemmed from her K-12 experiences. However, in the case of Samantha, her lack of kinesthetic experiences inspired her to teach science differently. As a college student, Samantha found a sense of enjoyment when doing laboratory experiments, thus inspiring to her make science more interactive for her students. Being a nontraditional student with a child, Samantha internalized her beliefs differently with respect to helping children make connections to their lives.

Samantha's teacher preparation program did influence the strategies she used to teach science. As she indicated, the science methods course made her more aware of the need to include different strategies when teaching science. Samantha found that both the science methods course and physical science course supplied her with the necessary tools (e.g. science content knowledge, activities, strategies) to be a better, more resourceful science teacher. It must be noted, however, that Samantha felt somewhat hindered in what pedagogical tools she could use as a result of the low reading ability of some of her students. Nonetheless, because she was determined to provide quality science instruction to each of her students, Samantha also incorporated ideas from her university supervisor and cooperating teacher. As Samantha implemented the UDL model for lesson development, she found that her classroom students influenced the strategies used to teach science. Using a variety of strategies, Samantha worked relentlessly on her lesson planning to meet the challenge of teaching science to students who were reading below grade level. With each science lesson, Samantha gained more confidence in her teaching ability.

Because Samantha was a younger nontraditional student teacher, her cohort members did not consider her to be a "mother" figure. However by being married and a mother, Samantha appeared to have an advantage when compared to her more traditional classmates due to those life experiences—e.g., when it came to understanding parental responsibilities and how to be more focused and efficient with class time. Having a daughter under the age of two years impacted how Samantha selected her teaching strategies. For example, being a parent reinforced the importance of safety and using her class instructional time wisely. Due to Samantha's past experiences and having a daughter that responded better to hands-on activities, she was able to better adjust to meet the needs of her second grade students.

With the influence of her teacher preparation program, university supervisor and cooperating teacher, Samantha developed more interactive science lessons that met the needs of her students. Working with her university supervisor and cooperating teacher, Samantha used effective communication as vehicle to incorporate multiple strategies that assisted her students in understanding science concepts. Using both verbal and nonverbal communication during her science teaching, Samantha was able to help her students transition from one lesson to the next. Samantha's teacher leadership qualities were brought to the forefront as she implemented different strategies to help the students who were reading below grade level.

At times, however, Samantha conceded that implementing new science strategies was at times frustrating. Nonetheless, Samantha was determined to identify and use strategies that could engage all her students in active learning. This effort was evident as Samantha introduced more hands-on activities during her science activities. Working with course instructors, university supervisors, and her cooperating teacher, Samantha also developed a language that was more cultured and encouraging. As a nontraditional student working with her cooperating teacher, Samantha's maturity and life experiences allowed her to position herself more as a peer. The transfer of teacher knowledge was more fluent since Samantha could identify with her cooperating teacher on multiple levels. Even though Samantha entered the identity-in-practice relationship with ideas stemming from her life experiences and parental responsibilities, she felt intimidated by science. Through identity-in-practice, Samantha transformed the knowledge gained from her science coursework to become more assured as a science teacher. Samantha's parental knowledge played a role in her development as a decision maker and knowledge facilitator, but her life experiences appeared to play an even greater role in her development as a science teacher.

Chapter Five: Results and Findings for Sarah East

This chapter is a descriptive case study involving student teacher-participant Sarah East (pseudonym). To gain a better perspective of how Sarah negotiated the teaching of science, this chapter discusses how her beliefs and life experiences impacted her identity development as science teacher. Additionally, this chapter also describes the ways by which Sarah's teacher preparation program influenced her identity development as a science teacher. Focusing on the two guiding research questions, the data presented in this chapter was acquired through interviews and classroom observations.

Case Study Two: Sarah East

Research Question 1. *How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?*

This section focuses on Research Question 1, which looks at Sarah's beliefs and life experiences as they relate to her identity development as a science teacher. Understanding Sarah's life experiences and family influences, as well as how she viewed science and the teaching of science, facilitated greater insights into the development of her identity as a science teacher. This knowledge then provided a framework for interpreting the role that beliefs and life experiences may play in the development of nontraditional students as elementary science teachers.

Beliefs and Life Experiences

Sarah entered Mountain View University's teacher preparation program with her own beliefs about science and how science should be taught. Sarah did not have any distinct recollections of her own experiences as an elementary school student learning science. It was not until Sarah entered high school that she remembered conducting science experiments. However, she stressed that high school science was more mathematically driven; in fact, it was difficult for her to separate the two subjects. Although she did recall conducting science experiments at the college level, Sarah's most vivid science recollections and descriptions were related to her high school experiences:

> I remember chemistry in high school. Lots of math…did not really enjoy it...I remember using the Bunsen burners and combining things. Exploring…exploring again…hands-on…exploring. (Sarah transcript 1, p. 4, lines 69-73, 4/3/13)

Sarah used the word "exploring" numerous times when describing science. During her first interview, Sarah made the distinction of how college science courses were divided into lecture and lab. It was not the lectures that stood out in Sarah's mind, but the "exploring" aspect of science (Sarah transcript 1, p. 4, lines 82-87, 4/3/13).

Despite the lack of science experiments at the K-8 level, Sarah clearly indicated her preference for learning science through hands-on activities. During the interviews, Sarah spoke of how hands-on activities and labs were an important part of science instruction and represented a better way to learn science: "If I do it, I tend to remember it" (Sarah transcript 1, p. 5, line 103, 4/3/13). Her commitment to hands-on activities was evident during her science instruction in that she incorporated demonstrations, engaging activities and other pedagogical practices that would involve the children observing, questioning and investigating.

As an older nontraditional student, Sarah entered Mountain View University with a variety of life experiences. One of Sarah's life experiences that appeared to impact her identity as a science teacher was the time spent with her mother, who operated a daycare in the basement of their home. When Sarah returned home from elementary school, she spent time working at her mother's daycare, which gave Sarah the opportunity to observe and interact with her mother as a teacher. Even at that young age, Sarah was working with her mother in an apprenticeship relationship, thus shaping her teacher identity. It was this identity-in-practice relationship with her mother that caused Sarah to select teaching as a career. Sarah also enjoyed working with younger children. When asked about who influenced her in deciding to become a teacher, Sarah talked extensively about her mother:

> But in terms of influential people, it would probably be my mom. She worked in the school as an aid. She did not finish college and then ran a home daycare. We always had little kids around. You know she did go back to school. Now has her masters and works with Head Start. (Sarah transcript 1, p. 1, lines 17-22, 4/3/13)

Thus, that daycare experience highly influenced Sarah's beliefs about teaching, as well as reinforced the importance of having structure and stability.

Another key experience for Sarah in her identity development as a science teacher was her K-12 science instruction. Sarah attended a private Catholic school in California, which provided a strict learning environment and focused mostly on the language arts. As Sarah note, "Science and history…I will be honest were an afterthought" and science was not taught until sixth grade (Sarah transcript 1, p. 3, lines 56-57, 4/3/13). While Sarah credits her strong vocabulary to her Catholic school experience, her K-12 schooling—although 30 years behind her—still affected how she approached teaching science. When she was designing science lessons she reflected on her prior school experiences and what she liked as a student:

> One of the biggest influences is the way I was taught which was called drill and kill, which was not so successful for me. I need that (hands-on) and I knew that when I started teaching I knew that I did not want to be that type of teacher. So I have always looked for other methods where I can keep the kids moving and doing things like the science labs. Like this I could have given the kids a worksheet on roots, but I knew that I would have hated it, and I wouldn't have learned very much from it, but something where they have to go find it and work together as a team. They are going to be more inclined to learn it. And so that has been a huge influence on all of my teaching. (Sarah transcript 2, p. 6, lines 117-125, 4/11/13)

Sarah's identity as a science teacher was deeply rooted to her prior school experiences and her personal learning style. Specifically, Sarah indicated that she was more inclined to select strategies that reflected how she learned best and found enjoyable. With the image of "drill and kill" etched in her mind, Sarah was determined to use that strategy sparingly. Based on her interviews it was evident that Sarah's life experiences played a role in her identity development as a science teacher. Being more 20 years older than her traditional classmates, Sarah relied on her life experiences to shape her identity as a science teacher in that she tended to be more focused and deliberate in her choice of pedagogical strategies.

Family

Like many other traditional students, Sarah was the child of a parent who taught children. However, Sarah was in the minority when it came to being married and having a middle school-aged child. During her second interview, Sarah talked about how her family—and in particular her son—influenced her development as a science teacher. Her son was a sixth grader who was not particularly enamored by science. Thus, Sarah understood that some students may not have confidence in their ability to learn science, and those were the students she wanted to reach. Sarah, in fact, frequently mentioned her son and what he liked and did not like as a teenager and as a sixth grade student. Being a parent provided insights into not only how her son learned best, but also gave her access to his middle school science assignments—some of which she would adapt for her own science lessons.

During all five classroom observations, Sarah made reference to either her son and/or to her parental knowledge. On one occasion her students were asking if they had science homework since they had completed their science worksheet. Referring to the homework policy of her son's teacher, Sarah tried to explain to her sixth grade students that they always have homework. Sarah explained to them that her son did not always have written science homework, but that his classroom science teacher expected him to read over his notes each night. On another occasion, some of her students were talking about playing soccer; Sarah engaged in conversation with them by telling them that her son played soccer. By sharing her son's experiences during her science instruction, Sarah was able to enhance her identity as a science teacher and make personal connections with her students.

Like Samantha, because she had a family Sarah felt the need to be organized and to prepare her lessons ahead of time. After a class observation, Sarah talked about having to be prepared in case her son was sick or if another family emergency arose. Being organized helped Sarah balance her role as a mother and as a student teacher, which was evident from the first classroom observation; Sarah made very efficient use of her classroom time. If a spare moment arose at school, she was quick to grade papers or work on other teacher-related duties such as designing lessons.

As a parent, Sarah had attended many parent-teacher conferences, which helped her understand what schools expected of parents, as well as what parents generally expected of schools and classroom teachers. As a student teacher, this parental knowledge was influential in her development as a science teacher. Sarah relied on her prior parental knowledge when she talked to a student who was about to throw away graded papers. Sarah commented:

> I don't know if they go home with the kids. It bugs me sometimes because I know that my kid doesn't bring home everything, but he brings home a chunk. We talk about it. I know what he is doing and I ask him how this is going. How did you do on this? Do you know? I hope that those parents have conversations with their kids. Then that shows the kids that they value school. Kids will put in the effort at that point. (Sarah transcript 2, p.13, lines 266-271, 4/11/13)

Sarah was very aware of the influential role a parent plays in the success of a child in school. On several occasions, Sarah talked with her classroom students about being a parent and wanting to see her son's science papers.

As a nontraditional student who was also a parent, Sarah relied on her parental identity to help her enhance her science teaching, as well as connect with her students on a different level. The students could relate to her parental side because of their own experiences with family members. Sarah used her parental experiences to reinforce the importance of taking their completed assignments home. Having attended parent-teacher conferences, Sarah understood the structure and dynamics of home relationships and the expectations of parents. Sarah's life experiences gave her an advantage in understanding the importance of encouraging parents to be active participants in their child's education. As a mother and teacher, Sarah understood the importance of reaching out to each student. Sarah life experiences allow her to enter the classroom with a wealth of knowledge.

Age

Nontraditional pre-service teachers must draw up their existing identities and funds of knowledge in order to develop as elementary classroom science teachers. Another important aspect of Sarah's identity development in comparison to traditional pre-service teachers was her age. Being older did not appear to bother Sarah. However, she did not socialize beyond school walls with her cohorts—Sarah's family obligations and responsibilities took precedent. However, by having more life experiences, Sarah was able to use these experiences as a resource to enhance her identity as a science teacher.

Being older and having greater confidence in her identity as a parent, Sarah was able to draw upon her knowledge to maintain order during science instruction. She was very quick to remind the students about classroom rules and correct their behavior. The students did not appear to challenge her authority. As Sarah commented, “Being a little bit older and having my own child...I knew the things he liked and didn’t like. That definitely influenced me” (Sarah transcript 2, p. 5, lines 104-105, 4/11/13). Sarah’s prior knowledge helped her to make better decisions when it came to addressing the needs of her students, maintaining classroom discipline and having general conversations with her students.

Sarah’s maturity also helped her to be more reflective. Often young student teachers are not able to fully recognize their strengths and weaknesses as classroom teachers. However, Sarah reflected on how she knew “what [she] was good at presenting and what [she] wasn’t…the ways. It’s different sometimes [because] people are good at doing one thing. You know that played a huge role because I know what I could and couldn’t do” (Sarah transcript 2, p. 5, lines 107-109, 4/11/13).

Her cooperating teacher also informed me that Sarah’s life experiences and maturity gave her a greater advantage in the classroom as a student teacher. As a result of her prior experiences, Sarah’s cooperating teacher was able to provide her with more challenging tasks because her cooperating teacher knew that she could handle it. It was evident that Sarah’s science teacher identity was intertwined with her identity of being a parent. Her beliefs and life experiences were influential in her development as a science teacher. As a mature nontraditional student, Sarah was able to use her life experiences—and especially her relationship with her son—to make connections with her students, thus contributing to her development as science teacher. Based on her beliefs relating to science and science teaching, life experiences, family, and age, Sarah was able to navigate science pedagogy with significant success.

Influence of Teacher Preparation Program

Research Question 2. *How do teacher preparation programs influence the identity development of nontraditional students as science teachers?*

This section focuses on Research Question 2, which examines how the participant's teacher preparation program influenced her identity development as a science teacher. Looking specifically at Sarah's science courses, university supervisor, cooperating classroom teacher and experience in the classroom as a student teacher, this section seeks to understand these how these influences were related to her identity development as a nontraditional science teacher.

Attending Mountain View University

Sarah wanted to teach within the local school system, but did not have the proper credits or the student teaching experience to obtain her state teaching license. As a result, Sarah enrolled in Mountain View University. With the expense of moving, purchasing a new home, keeping up with household bills, and having a middle school age child who was also an active soccer player, Sarah used student loan money to supplement her college expenses. Being new to the area and returning to school as a nontraditional student, Sarah was nervous about attending the university—so much so that she made a point of speaking face-to-face with someone at Mountain View to ensure that she was taking the proper courses to become an elementary school teacher.

Mountain View University's teacher preparation program features diverse programs that help to prepare teachers and administrators to work with children from birth through grade 12. As part of their training, pre-service teachers participate in practical field experiences within their fields of study. Mountain View's teacher preparation program offers courses that are taught by faculty members who have expertise and research experience in high impact teaching strategies, cultural responsiveness, instructional technology, and interdisciplinary teaching. As a nontraditional student who was a parent, Sarah could identify with the material being presented in courses such as human development; this gave her confidence to actively contribute to in-class discussions. Sarah could also identify with some of the female faculty members since she was a mother, especially when it came to balancing family and work commitments.

During her blocking experience, Sarah was assigned to work with a second grade teacher at a small urban elementary school during the mornings, while at the same time taking four in-class courses. For her in-class assignment, she was expected to design a two-week long social studies unit and teach the unit to her second graders. Following that successful blocking experience, Sarah began her student teaching experience. She was assigned to work with a sixth grade teacher. As a student teacher, she expected to take on full classroom teaching responsibilities, as well as design and implement a two-week long science unit.

As a nontraditional student, Sarah faced certain challenges as a student teacher. The challenges faced by Sarah included being able to organize her student teaching schedule with her family commitments, being more financially aware of extra expenses related to classroom teaching, and uncertainty of emergencies (e.g sickness) related to her son. However, as revealed during her second interview, Sarah relied on her prior beliefs about science and science teaching, life experiences, and her teacher preparation program to guide her in selecting strategies to teach science. These same experiences allowed Sarah to forge her identity as an elementary science teacher.

Science Methods Course

The science methods course was designed to offer pre-service teachers more concrete experiences for classroom application. For example, students used everyday materials to explore and practice effective science pedagogy. Importantly, the course also addressed the application of learning theories to science pedagogy, as well as how to incorporate national and Virginia Department of Education standards in planning and instruction. Sarah commented on the science methods course by saying that " it gave me a better… some newer, I guess, methods for teaching science…new ideas on how to engage the kids, how to keep them interested in science" (Sarah transcript 2, p. 1, line 3, lines 8-9, 4/11/13). Sarah continued to talk about how her teacher preparation courses influenced the strategies she used to teach science in the elementary classroom:

> Because I grew up with such a traditional…reading the books, study the notes, and spitting out the information, than doing more of the hands-on, labs, and things like that. So it allowed me to experience how I should do that which I really wasn't sure about before because I had never been taught that. (Sarah transcript 2, p. 1, lines 4-8, 4/11/13)

Sarah's understanding of her own pedagogical deficits enabled her to be more receptive to ideas presented in her science methods course. Her maturity and openness facilitated her use of materials presented in her science methods course to reshape her identity as a science teacher. Although Sarah felt confident in her ability to recall the science content, she had not previously understood how to present the science content in more understandable ways for young children, which she attributed to her lack of science experiences as an elementary student.

As Sarah worked with the course instructor, she became more confident in using a variety of strategies to present science concepts. Sarah's science methods course was instrumental in giving her more specialized tools so that she could teach science more effectively, thus enhancing her identity as a science teacher. Sarah also reported that her teacher education program helped her to prepare better science lesson plans by incorporating UDL (Universal Design for Learning) guidelines, which gave Sarah the tools necessary to reflect on how to reach all of her learners. It was important for Sarah to use different strategies and not to rely on the way she learned best. Her willingness to consider other strategies was an indication that Sarah's identity as a science teacher was transforming. Learning how to teach—coupled with her in-class experiences—helped to shape Sarah's identity as a science teacher. Sarah's teacher identity was fashioned, refashioned, and confronted as she adapted to different educational perspectives such as those of her teacher education programs, local schools, cooperating teachers, and classroom students.

Student Teaching Cohort

As noted in Chapter 4, Mountain View's teacher education program requires pre-service teachers to be divided up into cohorts, which then work together during their blocking and student teaching placement. Sarah's blocking experience included classroom observations, attendance at school level meetings (usually targeting staff development), and working with a classroom teacher. As part of the blocking experience, cohort members also attended educational courses together. During Sarah's final semester at Mountain View, her cohort group taught at the same elementary school, located only a few blocks away from Mountain View. Each cohort member worked with a different teacher, but interacted with each other to develop lesson plans. A university faculty member and a cooperating teacher supervised the student teachers. The primary objective of student teaching was to acquire and subsequently demonstrate instructional competence.

The formation of student cohorts was also intended to encourage mutual support—especially in designing lessons. Sarah understood the purpose behind working in cohorts and appreciated being able to share ideas. However, apart from what they shared as classmates and student teachers, Sarah did not really have much in common with her cohort members. Sarah was 20 years their senior, married, and had a child. She did note that although other cohort members did ask her to join them after work, Sarah declined. Her family came first and she wanted to be frugal with her money. Having a family and parental responsibilities changed her outlook on life, especially when it came to spending money. As a nontraditional student, the only thing that Sarah had in common with her cohort members was that they all wanted to be successful teachers. For instance, as an older student with different life experiences, Sarah understood that unforeseen events could occur, such as an illness or accident. Thus, Sarah was more likely to get ahead on lesson planning in comparison to her cohort members who had more free time to work on their science lessons once they arrived home from school. But with life's uncertainties (e.g., a sick child), Sarah was unwilling to put off writing her science lessons until the last moment. It was being parent with outside responsibilities that influenced Sarah to be more efficient with her time.

University Supervisor

Sarah was assigned two university supervisors to help mentor her transition into the teaching profession. Even though both supervisors offered advice, like Samantha she identified more with one than the other—in this case her special education supervisor. This individual routinely offered suggestions on classroom management and how to incorporate different classroom management strategies, which she found...

> …Very helpful with how you work with those kids who don't read so well. How do you get them on board with things like that? That's where she really played a role…like moving the kids around and stuff like that. But it really didn't have a lot of affect on the actual content or the teaching of science. (Sarah transcript 2, p. 2, lines 38-47, 4/11/13)

Given that Sarah had a couple of students who were reading below grade level, she found her supervisor's advice very useful. Even though her supervisor's advice was not related to science, it did assist with classroom management issues, which ultimately helped to maintain the attention of her students during science instruction. Her university supervisors' feedback on her science lessons enabled Sarah to incorporate different strategies that facilitated her success as a science teacher. The mentoring relationship between Sarah and her university supervisors positively influenced her identity as a science teacher, especially with the knowledge shared relating to classroom management and content delivery. As an older student with more life experiences, Sarah intuitively understood her shortcomings with respect to teaching sciences. As a result, Sarah was more open to learning new ideas shared by her supervisor that would benefit her students during science instruction.

Cooperating Teacher

After Sarah successfully completed her course requirements and her blocking field experience, she was ready to complete her student teaching. Sarah was placed in sixth grade classroom located in a nearby school and was tasked to work with a team of two teachers—one taught English and social studies, and the other taught mathematics and science. The mathematics/science teacher was Sarah's lead cooperating teacher. Prior to Sarah's arrival in the classroom, her lead cooperating teacher selected the topic of her science unit. As a student teacher, Sarah was expected to assume full responsibility for teaching that unit; she was also expected to design and teach a two-week long science unit. However, to provide additional experience, Sarah designed and taught mathematics, English and social studies lessons. By working with two teachers, Sarah was able to glean advice from both of them.

Sarah's primary cooperating teacher was skilled in elementary/middle education math and science, which was evidenced by the fact that there were numerous science and mathematics posters on the walls, as well as actual science quotes written the classroom walls. The mathematics/science cooperating teacher was very supportive of Sarah. He encouraged her to develop science lessons that included hands-on science activities and collaborative group work. Due to her maturity and early success at teaching, Sarah's cooperating teacher would frequently leave the room for extended periods of time. From time to time, however, the cooperating teacher—with Sarah's permission—would interject content when Sarah appeared to be struggling for more real-world examples. In so doing, Sarah and her cooperating teacher appeared to work more as a team when delivering science content.

Despite the close relationship with her cooperating teacher, Sarah expressed that she did not learn new ideas related to presenting science notes. The school's principal required the teachers to use a set of scripted, interactive notes when teaching science, which was intended to ensure that all of the students would receive the same content material. This presented a challenge for Sarah—namely, the "biggest way was keeping it in the format they had been using with the notes—the interactive notes," (Sarah transcript 2, p. 1, lines 30-31, 4/11/13). After reading over the required science notes, Sarah indicated that she "added my own activities and things like that around" (Sarah transcript 2, p. 2, lines 33-34, 4/11/13). Nonetheless, Sarah always consulted with her cooperating teacher to ensure that the appropriate strategies were being used to teach science and that she was presenting the content accurately.

The everyday conversations between Sarah and her cooperating teacher reinforced the benefits of identity-in-practice. Sarah's cooperating teacher shared ideas relating to classroom management, how to complete daily tasks, best science practices, as well as actual materials for science activities. As stated previously, Sarah was aware of her limitations as a teacher and valued the advice given by cooperating teacher. With identity-in-practice, Sarah was also able to observe her cooperating teacher in action. Sarah immediately identified with the more indirect techniques her cooperating teacher used to teach science, such as sharing personal information about family members and certain experiences that could connect with students. For example, as a result of hearing her cooperating teacher tell his students about his daughter's science project and how he had walked the Appalachian Trail, Sarah began to include more about her own personal experiences. These personal examples—e.g., the experience of growing up in California and how that differed from life in Virginia—helped the students learn more about Sarah and inspired more classroom discussions. As a nontraditional student, Sarah found that she had a lot in common with her cooperating teacher; they were close in age, were parents, and each had a passion for reaching all of their students. Being an older nontraditional student, Sarah entered the identity-in-practice relationship with more life experiences, which helped her to excel as a science teacher.

Content knowledge and pedagogical knowledge are only part of being a teacher. Working with her university supervisor and cooperating teachers, Sarah was able to connect her prior knowledge and experiences to practice. Since knowledge is a social construct, the identity-in-practice through apprenticeships supplied Sarah with the skills necessary to reshape her science identity. Through the student teacher-teacher apprenticeship, Sarah was able to learn how to blend her life experiences with her teacher preparation program experience, thus creating science lessons that were more dynamic. She also received immediate feedback from an experienced classroom science teacher with whom she could relate to on multiple levels, thus enriching her identity as a science teacher.

Experiences in Classroom

As Sarah and her cooperating teacher continued to work collaboratively, she was able to learn how to better identify the strengths and weakness of her students. When selecting strategies to teach science, Sarah found that her students were the most influential component. Sarah commented:

> The students probably played a bigger role than anything else. Because I knew that there were kids who could not sit and just listen, they needed those activities.

They needed labs. They needed to get up and move around and do the wind stuff outside. They needed that and I knew that. (Sarah transcript 2, p. 4, lines 77-80, 4/11/13).

It was not until she was student teaching that Sarah began to appreciate the knowledge acquired in her science methods course. As Sarah worked with her students more she saw the value in providing a variety of experiences for her students during science instruction. Drawing upon her prior coursework and life experiences, Sarah understood that there were students who did not learn well by traditional methods—e.g., copying notes from the board and listening to lectures. Thus, Sarah searched for better strategies to use when teaching science, as she described:

That would be why I made sure that I used as many of the videos that I could and if they wanted to read. Which I would help the ones who really wanted to read even though they struggle with it. Making sure that I was standing there right next to them feeding them the words as they go. So that they would feel confident and not get embarrassed about reading it incorrectly in front of the class. So I didn't want to discourage the reading; at the same time I don't want them ridiculed by other kids from trying to read and getting it wrong. (Sarah transcript 2, p. 4, lines 85-91, 4/11/13)

Sarah's teacher preparation program heightened her awareness that students learn differently.

The thoughts Sarah shared during the second interview were reflective of UDL's guiding principles as she talked about using different strategies to teach science. By incorporating UDL in developing science lessons, Sarah used numerous strategies to meet the needs of her students while integrating related science instructional objectives. As part of her pre-service teacher training, Sarah evaluated the success of each lesson by consulting with her university supervisor and her cooperating teacher. During her second interview, Sarah reflected back on her science methods course, which inspired her to use a variety of instructional pedagogies, “I tried to put that into the lessons giving them the videos, giving them the notes, giving them the lab activities, giving them lots of different ways to get the same information” (Sarah transcript 2, p. 1, lines 17-19, 4/11/13).

The strategies Sarah selected to teach science provided important insights into her identity development as a science teacher. When Sarah developed her sixth grade science lessons, she incorporated various sources of knowledge, in addition to knowing her students’ interests and abilities. Sarah also referred back to own her life experiences from being a student and a parent when designing and delivering science lessons. For instance, Sarah’s first lesson introduced the students to potential and kinetic energy. Through her mentoring relationship with her cooperating teacher and her own desire to know her students, Sarah developed a lesson that incorporated a variety of strategies. True to her beliefs and previous science experiences, Sarah included a number of hands-on activities. In order to help her students keep more organized notes, Sarah introduced her students to a new way of taking notes using preprinted unit booklets. To accommodate students who were more visual learners, Sarah included a video of a roller coaster. As a class, they identified where on the roller coaster the cars had potential and kinetic energy. The increasing number of questions they asked as they proceeded through the lesson confirmed their high level of engagement. The following vignette demonstrates Sarah’s approach to science teaching.

Roller coaster challenge: vignette. Sarah asked the students to think about what a roller coaster needs, but was specific about how she expected the less to unfold. First, she stated: "A roller coaster must gather P.E. [Potential Energy] before K.E. [Kinetic Energy]. Your job is to create your own rollercoaster. It must go in and come out of a hose." She handed the students lab paper, a portion of a garden hose tube, masking tape and a marble. The students could use as much masking tape as needed. The students seemed excited as they took their supplies to a location of their choosing within the classroom. Sarah walked around the room while the children were working. One group of girls was having trouble with their tube and Sarah walked over to help. Another group of boys who were not very focused during the note-taking portion of class stayed on task for the entire roller coaster challenge activity. They were the first to finish and sat calmly discussing how to answer any possible questions.

Once everyone finished, Sarah asked the student groups to "report out as to what happened. Did it work? One member must report, but all group members can contribute." All of the groups reported on their success, but one group of girls talked about how they had difficulty with the marble going through the first hose. Sarah made a point of saying that science was not always exact and errors do occur. As Sarah collected their lab papers, she asked the students to identify one important phrase that they talked about during that day. A couple of students responded, "Kinetic Energy!" Sarah repeated the definition and then asked: "What is another word?" A few students together replied, "Potential Energy!" Sarah then stated the definition of potential energy, after which she asked, "What is energy?" The majority of the students said: "It is the ability to do work." Even though the students watched a roller coaster simulation during the note-taking portion of the class, they struggled with labeling the roller coaster diagram on their lab handout. This was an adjustment that Sarah would have to make to that activity.

As Sarah reflected on her roller coaster activity, it was evident that she equated good teaching to presenting information in such a way that it was able to engender confidence in her students. When faced with challenges in teaching science, Sarah sought out a variety of strategies including evidence-based practices presented by her teacher preparation program. Sarah attempted to have her students apply the knowledge they gained during their hands-on activities by completing an activity sheet. However, Sarah found that the majority of her students struggled when asked to write about their findings, as evidenced by the fact that many asked how they should answer the questions on their activity sheet. Despite the fact that this was frustrating for Sarah, it made her revisit her science lesson plan—and specifically her roller coaster activity sheet. Having more life experiences (e.g., being a parent), Sarah was able to be more reflective and adjust to the needs of the students.

Summary of instructional strategies. As Sarah organized her lessons, it was evident during classroom observations that structure and routine were very important to her. For example, Sarah designed unit booklets to ensure that all of her students were able to keep their science notes organized during the 80 minutes of science instruction (Sarah classroom observation 1, 3/14/13). Given the longer length of class time, she needed a variety of activities to keep her students engaged. Relying on her past experiences and knowing that some of her students were more kinesthetic learners like her, Sarah included demonstrations and experiments.

With Sarah's teacher preparation program providing pedagogical content knowledge and inquiry-based practices, she was able to put theory into practice when designing her science lessons. Sarah also relied on her cooperating teacher for guidance when it came to selecting the most engaging activities. After consulting with her cooperating teacher, Sarah included a variety of examples, explanations and demonstrations to help her students make connections to their prior knowledge while learning new science material.

Based on five classroom observations of about 80 minutes each, it was clear that Sarah utilized a variety of instructional strategies to teach science (see Table 10).

Table 10: Science Instructional Strategies Used by Sarah to Teach Science

Instructional Strategy Category	Specific Strategy	Classroom Observations Evidence
Direct Instruction	1. Structured Overview	All
	2. Lecture	All
	3. Explicit Teaching	All
	4. Compare and Contrast	All
	5. Didactic Questions	All
	6. Demonstrations	Forms of Energy
	7. Guided and Share (Reading, Listening)	All
Interactive Instruction	1. Brainstorming	Potential/Kinetic Energy
	2. Peer Partner Learning	All
	3. Discussion	All
	4. Laboratory Groups	Potential/Kinetic Energy
Indirect Learning	1. Reading for Meaning	All
	2. Inquiry	Potential/Kinetic Energy, Forms of Energy
	3. Reflective Discussion	All
	4. Concept Formation	All
	5. Concept Mapping	All
	6. Concept Attainment	All
	7. Cloze Procedure	All
Independent Study	1. Learning Activity Packages	All
	2. Homework	All-Study or Questions
	3. Assigned Questions	All
Experiential Instruction	1. Conducting Experiments	Potential/Kinetic Energy
	2. Field Observations	Potential/Kinetic Energy Nonrenewable/Renewable
Table Note: (Observation-Title of Lesson) 1- Potential/Kinetic Energy 2- Potential/Kinetic Energy Nonrenewable/Renewable 3- Forms of Energy 4- History and Energy Use 5- Types of Radiation		

As part of being an effective teacher, Sarah drew from a collection of instructional strategies and models. Assisted by her university supervisor and cooperating teachers, Sarah adjusted the selected strategies to meet the needs of her students and the required specific learning objective. For Sarah, there were many occasions that demanded more traditional methods for conveying a concept, including expository teaching or teacher-directed learning. She utilized this strategy effectively when the students needed to learn specific kinds of knowledge—for example when defining new vocabulary terms (e.g., classroom observation 1, 3/14/13, potential and kinetic energy lesson). Prior to teaching science, Sarah would post all of the vocabulary words on the dry erase board. When a new term was introduced, Sarah would point to the word on the board and discuss the meaning of the word. If the word appeared again, she would summarize the definition.

When Sarah wanted her students to learn for deeper understanding, she implemented experiments, problem solving, collaboration, and manipulation of physical objects. During her *History and Energy Use Lesson*, the students observed a heat transfer demonstration using a lit candle and an index card (Sarah classroom observation 4, 3/21/2013, history and energy use lesson). Sarah included inquiry learning, cooperative learning, concept attainment, and class discussions as her selected strategies when her goal was the formation of cognitive structures. Cognitive structures include concepts, generalizations, dispositions and understanding rather than simple attainment of specific facts or mastery of discrete skills. For example, after spending time explaining the definition of potential energy and kinetic energy, Sarah asked her students to design a roller coaster to determine where the potential energy and kinetic energy was the greatest (Sarah classroom observation 1, 3/14/13, potential and kinetic energy). The roller coaster activity was specifically designed to help students who learn kinesthetically.

Through class discussions, cooperative learning and peer-mediated instruction, the students were also exposed to how their classmates processed science information. Given that her classroom contained five large tables, Sarah had the students working together on assignments. For example, at the beginning of each new unit the students worked together to write what they knew about the topic and what they would like to know. At the end of the unit, the students collaborated again to create a list of things that they learned, which they then shared with their classmates.

Sarah found it advantageous to use a variety of instructional pedagogies to teach science—and by so doing created an atmosphere in which all of her students could contribute to the learning process. Sarah designed science lessons that systemically built conceptual understanding. Influenced by her past school experiences, Sarah wanted all of her students to feel unrestricted in their learning. Accessing knowledge gained from her teacher preparation program and her own personal experiences, Sarah understood that in order to build student confidence, she had to make meaningful connections to their lives.

Working with her university supervisor, cooperating classroom teachers and students, Sarah reaffirmed her belief that good teaching amounts to more than just reporting information. Sarah used the identity-in-practice knowledge gained from her teacher preparation program and field experience to design age-appropriate science lessons and later reflect upon their effectiveness. With feedback from both her university supervisor and science cooperating teacher, Sarah enhanced her ability to reflect upon her teaching and the strategies she selected to teach science. Since knowledge is a social construct, Sarah's teacher identity was refined as a result of the feedback and knowledge acquired from all of her experiences.

Case Study Two Summary

As a nontraditional student teacher, Sarah entered her teacher preparation program with prior beliefs relating to science content and science pedagogy. Sarah did not have very many classroom science experiences until she entered middle school. In fact, her minimal exposure to science in her strict private Catholic elementary school was mostly drill/repetition based. Nonetheless, Sarah felt that science education should include hands-on activities. While she acknowledged that drills and practice were not her preferred way to learn science, she understood that a certain level of memorization was necessary for understanding essential principles. In contrast, Sarah reported that science should involve exploring and learning how things work.

Being an older nontraditional student, married, and a mother, Sarah appeared to have an advantage when compared to her more traditional classmates. Being older, Sarah had more life experiences to draw upon when teaching. Having a son in middle school impacted her selection of teaching strategies used to teach science; she was also very focused and efficient with her time due to her parental responsibilities. Her son's science education experiences also informed how she designed her lessons and interacted with her students. Being a parent of a middle school child also helped Sarah to connect with her students. These various factors (i.e., being an older teacher with more life experiences and having a child the same age as her students) contributed to her earning the trust of her students relatively quickly. As a result of their early acceptance of Sarah, her students appeared to be more inclined to try different instructional strategies without confrontation.

Sarah realized that she did not have many prior experiences with hands-on learning when she was a student; thus, she was not very familiar with teaching science using inquiry-based strategies. However, she talked about how her teacher preparation program influenced the strategies she used to teach science. In particular, the science methods course appealed to Sarah because she understood what her deficiencies were when it came to teaching science. As Sarah indicated, her science methods course was extremely valuable in providing the knowledge necessary to better facilitate science learning in an elementary classroom that incorporated inquiry-based learning strategies.

Sarah endeavored to ensure that her science lessons were more than just lecture based; she wanted to her students to be excited about learning science. Sarah also wanted to build the confidence of her students when it came to learning science, but it was a challenge for her to design lessons that would help her students overcome their fear of science. Sarah wanted her students to relinquish any "I can't do it" attitudes. As a result, Sarah searched for ways to present the science content in more creative ways—e.g., using UDL guidelines to frame her lessons. Over time Sarah concluded that her students had the greatest influence on the strategies she selected to teach science.

With the influence of her teacher preparation program, university supervisor and cooperating teacher, Sarah developed science lessons that met the needs of all of her learners. Working with her university supervisor and science cooperating teacher, Sarah incorporated multiple strategies in order to ensure that her students understood science concepts. Using both verbal and nonverbal strategies during her science teaching, Sarah was able to help her students build on their skills and expand their knowledge. Sarah's teacher leadership qualities were brought to the forefront as she implemented new and different pedagogical strategies that were unfamiliar to them—for example, her introduction of science note booklets for science note taking. Working with course instructors, university supervisors, and her cooperating teachers, Sarah expanded her science education efficacy to the benefit of her students.

As a nontraditional student working with her cooperating teacher, Sarah's maturity and life experiences allowed her to position herself more as a peer. The transfer of teacher knowledge was more fluent since Sarah could identify with her cooperating teacher on multiple levels. Even though Sarah entered the identity-in-practice relationship with a certain level of confidence that stemmed from her life experiences and parental responsibilities, she felt intimidated by science. Through identity-in-practice, Sarah transformed the knowledge gained from her science course work to become more self-assured as a science teacher. Sarah's life experiences, maturity, parental knowledge and leadership qualities played a role in her development as a classroom decision maker and knowledge facilitator.

Chapter Six: Discussion

Introduction

This study investigated the influence of beliefs, life experiences, and teacher preparation programs on the identity development of two nontraditional female students as elementary school science teachers. In observing the interactions and conversations of these two women, it became apparent that they entered the teacher education program with their own perspectives on learning and teaching science—both of which were rooted in their personal beliefs and life experiences. By observing these nontraditional student teachers within a sociocultural framework using an identity-in-practice lens, I was able to identify and interpret how those factors affected the strategies they used to teach science in the elementary classroom.

The development of each participant's identity as a science teacher was affected by their own established system of beliefs, life experiences, and the teacher preparation program. Identifying specific strategies used to teach science illuminated how the nontraditional student teachers leveraged their beliefs about science pedagogy within their teacher preparation program. The strategies participants used also revealed how the knowledge and theories presented by their teacher preparation program influenced their ability to make effective science teaching choices.

As discussed in Chapter Two, research suggests that prior beliefs, life experiences, and teacher preparation programs influence the identity development of pre-service teachers. The knowledge gained from the literature provided a foundation for understanding the potential impact of these factors on the identity development of nontraditional student teachers as elementary science teachers. In terms of this chapter's organization, the first section examines emerging themes and their relationships to the two research questions. In addition, each emerging theme is discussed in relation to both the literature and the data provided by each participant. The second section revisits the literature by providing a sociocultural lens through which to view the participants as nontraditional pre-service teachers. Finally, this chapter discusses the limitations of the study, and describes the implications of this investigation with respect to its scholarly contributions in the areas of nontraditional pre-service teachers, teacher educators, teacher preparation programs, and elementary school science.

Discussion of Themes

The study identified the strategies that Samantha and Sarah used teach science in their elementary school classrooms; specific influences were also accentuated to provide a rationale as to why these particular strategies were implemented. Through textual analysis of the participant interviews, classroom observations, field notes, and related documents, four themes emerged from this study that relate to the two research questions:

Research Question 1. *How are the beliefs and life experiences of nontraditional elementary pre-service teachers related to the development of their identities as science teachers?*

Theme 1: The identity of nontraditional student teachers as science teachers was related to early experiences in science classes.

Theme 2: The identity of nontraditional student teachers as science teachers was influenced by their role as parents.

Research Question 2. *How do teacher preparation programs influence the identity development of nontraditional students as science teachers?*

Theme 3: Nontraditional student teachers learned strategies that supported their beliefs about inquiry-based learning.

Theme 4: Nontraditional student teachers valued the teacher preparation program support system.

Each theme-related finding is discussed below in relation to the research presented in the literature review.

Research Question 1. Theme 1: The Identity of Nontraditional Student Teachers as Science Teachers was Related to Early Experiences in Science Classes

The evidence supporting Theme 1 confirms that nontraditional student teachers enter their teacher preparation programs with established beliefs relating to the teaching of science. Participant interviews revealed that K-12 science teaching experiences were influenced by their beliefs about how science should be taught. Through observations and interviews it became apparent that these findings are consistent with the research of Bodycott, Walker and Lee (2001) with respect to the participants being student teachers, who indicated that new teachers enter the profession with established beliefs and principles related to teaching strategies.

Knowing that the formation of one's identity is an active process and is constantly evolving, this study examined how each participant's science classroom instruction influenced her identity as a science teacher. Hollingsworth (1989) found that student beliefs about teaching were a product of how they learned in school. Samantha and Sarah were no exception. For Samantha, science content needed to be presented sequentially, and the teacher should not introduce new material until existing content/skills have been mastered. Observations and interviews revealed that Samantha found it difficult to teach new science content knowing that some of her students did not understand. In contrast, Sarah learned best through mastering vocabulary and keeping organized. She emphasized expanding her students' vocabulary and having them use science booklets to keep their notes organized. As observed, pre-service teachers like Samantha and Sarah enter college with an idea of what constitutes an ideal teacher, which stems from their prior classroom teachers. Since identity is shaped by both external and internal factors, it is impacted by social, institutional, historical and personal experiences. The way that Samantha and Sarah viewed their early experiences as science learners helped to shape their identity as classroom science teachers.

As Hollingsworth (1989) asserted, a student's pedagogical beliefs are directly impacted by how she or he learned best in school. For Samantha, the experience of having to repeat chemistry only reaffirmed her belief that science concepts need to be logically presented and sequentially—that sequential learning is an important approach to learning science material. She believed that it was also important to teach for mastery. Additionally, paralleling the research of Bonwell and Eison (1991), it was observed that Samantha would model her expectations to encourage more interaction. For example, she would first read a thermometer out loud to the class; then she would have a student assist her in reading the thermometer orally to the class; and then finally she would have the students read a thermometer collectively without any assistance from her. She also encouraged her students to discuss their findings. Samantha was patient with her young students, but she was also very conscious about time management and the short attention span of her students. In fact, Samantha became very frustrated when her students did not put forth the effort to learn.

In an attempt to motivate her students, Samantha tried a variety of instructional strategies when teaching science. She found that hands-on science activities kept all of her students engaged for longer periods of time. However, due to limited instructional time, Samantha struggled with introducing new science concepts when some students did not fully understand what she had previously taught. Reflecting back on past K-12 experiences, Samantha understood the frustrations felt by some of her students. Despite her innate desire to maintain order, Samantha did understand the importance of having her students work together when doing science activities. Samantha believed that hands-on experiences were valuable in reinforcing science concepts, and that inquiry-based science instruction gave the students a more enjoyable venue for learning science. In short, Samantha found that all of her students enjoyed science when she used active learning strategies that induced greater student participation.

Classroom observations and interviews revealed that Sarah believed that students learned best when they were actually doing science. Importantly, it became apparent that Sarah's private Catholic school environment influenced her beliefs about teaching science. She stressed that there should be order in the classroom to promote maximum science learning—and actively maintained order while teaching when students were off task or disobeying classroom rules. To be more efficient with limited science instructional time, Sarah understood that everyone needed to be on the same page; thus, she planned her lessons accordingly. As a result of essential vocabulary requirements in the science curriculum, Sarah believed that it was important that her students be knowledgeable of science terms. In fact, Sarah was observed to use terms that were unfamiliar to the students. When students expressed their confusion, she took the time to clarify meaning, which prompted interactive classroom conversations.

Sarah believed that students should value their education and should not fear what they do not understand. Her prior science classroom experiences enhanced Sarah's confidence as a leader and her desire to meet the needs of all of her students. Sarah wanted each of her students to be successful and not be intimidated by science. In contrast to her own elementary school experiences with science, she wanted her students to learn from the inquiry-based experiences that she did not have as a young student. Along with her desire to instill confidence, Sarah also believed that her students should enter her classroom prepared to learn. She had high expectations for her students. While drawing upon her life experiences (e.g., as a student and mother), Sarah searched for ways to tap into the individual strengths of her students.

As nontraditional students, Samantha and Sarah entered into their teacher education program seeking ways to assimilate their prior knowledge and beliefs with the new information being presented. As science teachers, Samantha's and Sarah's identities were influenced by their science classroom instruction. The fact that neither had much experience with hands-on experiences in school did not deter them from designing more inquiry-based science lessons for their own students—in fact, it had quite the opposite effect. They were able to embrace the knowledge gained from their classroom science experiences (including lack of inquiry-based experiences) and use that information to become more dynamic as science teachers.

Research Question 1. Theme 2: The Identity of Nontraditional Student Teachers as Science Teachers was Influenced by Their Role as Parents

Connecting to the first research question, qualitative evidence supports Theme 2—that being a parent influenced the beliefs of both nontraditional student teacher-participants towards the teaching of science. Data analysis confirmed that Samantha and Sarah's family responsibilities had a positive effect on their success in teaching science. Okun, Ruehlman and Karoly (1991) examined the persistence of nontraditional undergraduate students and found that family members can heighten that student's awareness of college being an investment. For Samantha and Sarah, completing their degree was an investment in helping to improve their family's financial stability. More importantly, completing their degree was an investment in themselves. By having family members that were educators, Samantha and Sarah understood that education provided greater accessibility to becoming financially stable.

As noted by Kirby et al. (2004) and Mooney (1994), nontraditional students like Samantha and Sarah have to organize their school responsibilities around other demands such as family and work. For instance, Samantha delayed working on her schoolwork and lesson planning until her daughter was asleep. With an older son, Sarah would have to leave school, pick him up, and take him to soccer practice. Once his soccer practice was over she would return home, take care of household related activities first, and then work on her lesson plans.

Hooper (1979) observed that nontraditional female students who have more traditional family roles and responsibilities experienced more guilt over returning to school. Samantha's guilt stemmed from not being able to spend more time with her daughter; however, the presence of her daughter also encouraged her to return to school. Sarah's guilt stemmed from not being able to spend more time with her family and not having the extra money to purchase things for her family. Despite their misgivings, both women viewed their return to school as an opportunity to contribute more to their family's income. Returning to school also facilitated each woman's dream of becoming a teacher, as well as being a good role model for their children.

Reinforcing the findings of Okun, Ruehlman and Karoly (1991), Samantha's and Sarah's parental responsibilities positively influenced their success in teaching science. Their interactions with their own children gave them greater insights into how young children learn, how to maintain an inviting, but disciplined classroom environment, and how to involve parents in a student's education. For example, by being a mother to a young child, Samantha was more aware of safety. She understood the importance of keeping her explanations simplistic and being organized to promote efficiency.

As the mother of a middle school-aged son, Sarah did have more flexibility with her personal time in comparison to Samantha since Sarah's son did not require as much maternal attention. Additionally, being a parent of an older child meant that Sarah had more experiences related to school functions—e.g., attending parent-teacher conferences, school-related field trips, and organized sporting events. Sarah was also more experienced in helping her child with homework and projects, assisting with providing structure and discipline. When planning science activities she thought about what her son liked. Sarah was able to relate well with her sixth grade students because she her son was also in sixth grade. As a parent, Sarah felt well equipped to engage in more meaningful conversations with other parents about community activities and to share what her son was doing in school.

For both nontraditional students, their parental responsibilities gave them greater insights when it came to designing their science lessons and relating to their students. As they worked with their classroom students they drew upon their parental skills in being more nurturing; both indicated that they thought of how they would want someone to treat their child in the classroom setting. They also had a greater understanding of how to manage time due to family obligations; both were very efficient with any available spare time. Due to possibility of family emergencies (e.g., a sick child), both women designed lessons well in advance of the expected due dates. Thus, this investigation confirmed that the identity development of nontraditional students as classroom science teachers is informed by their role as a parent.

With their multiple identities, nontraditional pre-service teachers cannot be compartmentalized, but must be viewed from a "multi-membership of many communities" perspective (Wenger, 2000, pg. 159). Both participants were extensions of their different communities of practice, including being both a student and a parent. In order for them to negotiate their role as science teachers, Samantha and Sarah needed to understand the educational community and their position within it. Wenger noted that "in practice, we know who we are by what is familiar, understandable, usable, negotiable," (p. 153)—but also by what is unfamiliar. Relying on their familiar role as a mother, both women were then able to establish a productive link with the unfamiliar realm of the science classroom. Samantha relied on her experiences with her young daughter, while

Sarah did the same with her son; as a result, both were able to transition into the teaching of science with greater efficiency and effectiveness.

As student teachers, Samantha and Sarah used their classroom engagement to access, strengthen, and align all of their identities (i.e., student, student teacher, parent) to be more reflective of successful elementary science classroom practices. Samantha's and Sarah's multi-membership enhanced their ability to reflect upon their teaching from different perspectives. Samantha thought about her daughter when designing science lessons that were safe and efficient, while Sarah purposefully selected science activities that she felt her son would enjoy were he in the classroom.

Research Question 2. Theme 3: Nontraditional Student Teachers Learned Strategies That Supported Their Beliefs About Inquiry Learning

Connecting to the second research question, evidence that supports Theme 3—namely, that both women's beliefs about elementary school science pedagogy influenced how they received and processed information learned in their teacher preparation program. Similar to any student teacher who begins a teacher preparation program, Samantha and Sarah had established beliefs about how science should be taught, which supports the known literature (e.g., Joram & Gabrielle, 1998; Wubbles, 1992; Seichner & Gore, 1990). While it was evident that their beliefs reflected their own experiences in school, they were also willing to consider other options.

As part of their teacher preparation program, Samantha and Sarah were required to take a science methods course. Samantha found her science methods course to be beneficial in that it provided a variety of strategies related to assessment, vocabulary, and content delivery. Sarah reported that her science methods course experience gave her better ideas on how to teach science, as well as strategies that would help keep her classroom students engaged and interested in science. Both gained in teaching confidence as a result of this course. With its focus on inquiry-based science instruction, the science methods course was designed to expose pre-service teachers to a variety of science strategies that they could then use to make science more meaningful.

The tools or artifacts that Samantha and Sarah used influenced their cognitive processes. In this study the term "tool" is a symbolic reference to the language or other materials used by the instructor to perform tasks. Samantha and Sarah developed their cognitive structures using such tools while they participated in everyday school practices and activities such as teaching, lesson planning, and interacting with students, fellow pre-service teachers or faculty. The science methods course reintroduced the participants to educational terminology that reinforced their beliefs about inquiry-based learning, while at the same time provided information on current education practices that might be unfamiliar (e.g., Universal Design for Learning). Samantha's and Sarah's teacher preparation program influenced how they assimilated new information relating to teaching and learning. Through various assignments and projects, the course helped Samantha understand the importance of making science more interactive. She also credited her science methods course in helping her to differentiate her science lessons. Similarly, because Sarah did not have a strong science background and lacked hands-on experiences, she reported that the science methods course helped her learn how to teach science. Specifically, it empowered Sarah to implement a variety of instructional strategies for teaching elementary school science, while at the same time making it more engaging for her students. Both Feiman-Nemser et al. (1989) and Holt-Reynolds (1992) opined that many pre-service teachers initially believe that a teacher's role is simply to pass on knowledge to their students. Indeed, the prior learning experiences of both Samantha and Sarah reinforced that traditional model. However, their science methods courses helped to open their eyes that the teacher's role is really to aid their students in becoming knowledge producers. In order to achieve this goal, both women mobilized numerous strategies such as such as highlighting notes, questioning, demonstrations, and oral reading to deliver the science content and empower their students (Holt-Reynolds, 1992). As part of their teacher preparation program, Samantha and Sarah were also able to use UDL guidelines to help select the most appropriate science strategy.

As Samantha and Sarah worked with their university supervisor and cooperating teachers, they gleaned valuable insights including how to assess their students and how to incorporate different strategies when teaching science. Each woman's teaching style reflected her beliefs about how science should be taught. For instance, it was evident that Samantha equated good teaching to presenting information in such a way as to illicit more participation from those students who were reading below grade level; thus, Samantha attempted to use a variety of strategies to teach science. Sarah equated good teaching with providing a variety of activities to help meet the needs of each and every student. Both participants equated good teaching with a highly organized and well-managed classroom environment.

Research Question 2. Theme 4: Nontraditional Student Teachers Valued the Teacher Preparation Program Support System.

As part of their teacher preparation program, Samantha's and Sarah's science teacher identities were reshaped and strengthened as they prepared to teach their science unit during their field placement. Applying the knowledge and tools supplied by their teacher preparation program, Samantha and Sarah took ownership in their development as classroom science teachers. As nontraditional students, the women's identities as science teachers became a function of their knowledge, beliefs, self-efficacy, and classroom practices (Drake, Spillane, & Hufferd-Ackles, 2001). As student teachers, Samantha and Sarah found value in their teacher preparation program. Given that they entered the program with their own beliefs as to how science should be taught, they were mature enough to appreciate the advice and recommendations given by their instructors. As suggested by Wenger (1998), Samantha's and Sarah's field experiences gave them the opportunity to "invest in" science teaching and develop a relationship with other people, thus "gaining a lived sense of" being a science teacher (Wenger, p. 192). Working closely with university supervisors and cooperating teachers, Samantha and Sarah realigned their identity as a science teacher to better meet the needs of their students.

Most teacher education programs provide opportunities for pre-service teachers to work together. One such opportunity for social engagement and collaboration is through field experience cohorts, which are formed among pre-service teachers during their blocking experiences and student teaching field experiences. Samantha and Sarah were both part of a cohort based on their student teaching assignment. As a cohort member, Samantha and Sarah were able to discuss with fellow student teachers the various successes and challenges associated with their science teaching or science lesson planning.

As nontraditional students, it was evident that Samantha and Sarah were able to identify with their mentors on multiple levels. "Given that identity is rich and complex because it is produced within the complex relations of practice" (Wenger, 2000, pg. 162), nontraditional students were able to use their prior experiences to negotiate their entrance into the teaching profession. Being parents and having other "adult" responsibilities, Samantha and Sarah were able to identify with their cooperating teachers on a more personal level.

As student teachers, Samantha and Sarah were able to learn through practice, thus become more engaged in the science education community. Through identity-in-practice, Samantha and Sarah understood that the teaching profession wasn't just about planning curriculum and delivering science content; it also encompassed research, classroom management, regulations, relationships, and other educational practices. As Samantha and Sarah journeyed through different educational landscapes, they drew upon their various identities to enhance their success as classroom science teachers. Relying upon their multi-membership and mentorship, Samantha and Sarah were able to make connections that enhanced their science teaching knowledge. The women then used this knowledge to make better decisions about science instruction, the direction and priorities relating to science content, how to cultivate better relationships with students, parents, and other teaching professionals.

As part of their teacher preparation programs, Samantha and Sarah worked with two assigned university supervisors and a cooperating classroom teacher. Lortie (1975) referred to this type of engagement as an "apprenticeship of observation" (p. 65). While it was apparent that both women relied on their prior classroom experiences, they were also open to new ideas when teaching science. For example, Samantha's university supervisor was a reading specialist who shared his vision for using children's literature books to introduce science concepts. As a result of having limited class time to teach science, Samantha was able to use her reading instructional time to talk about science.

Sarah identified more with the supervisor who was a Title I specialist. This individual suggested specific types of reading strategies that could be used to engage more of her students during science: pairing her lower readers with stronger readers, and keeping key science vocabulary terms on the board throughout the unit. Sarah also applied her supervisor's advice to improve her classroom management skills (e.g. rearranged student seating, moved nearby students who were reading orally to help them pronounce words).

As suggested by Rogoff (1990), a cultural apprenticeship exists between the learner and social agents, such as a cooperating teacher who shares the tools required for successful science teaching. Samantha's and Sarah's cooperating teachers provided critical insights into how to better identify the educational needs of their students. Samantha credited her cooperating teacher with introducing her to a variety of pedagogic strategies—but especially the use of interactive notebooks. Moreover, as Samantha worked closely with her cooperating teacher she acquired the tools necessary to work successfully with students who were reading below grade level. Those tools included behavior management suggestions, activity sheets, and lesson modification advice. The social interactions between Samantha and her cooperating teacher, such as the use of "teacher language," were intended to help transition Samantha into the role of an independent science teacher.

Sarah's cooperating teacher also contributed to her development as a classroom science teacher. Not familiar with using interactive notes as a way of presenting science content, Sarah's cooperating teacher worked with her in selecting activities to make her lessons more engaging for the students. Like Samantha, the various social interactions between Sarah and her cooperating science teacher (e.g., learning her "teacher language") enabled Sarah to access the proper tools for promoting thinking and problem-solving among her sixth graders (Wertsch, 1985). Sarah still could not remove herself completely from how she was taught in school; this was evident in the time Sarah spent working with her students to teach science terms and organizational skills, which were reflected in her "note booklet" design.

As student teachers, Samantha and Sarah were not just passing on science knowledge, but were striving to ensure that their students were able to understand the science knowledge so that they could subsequently reproduce it multiple ways. Because of the various challenges their students faced (e.g., some low-level readers), Samantha and Sarah used the advice given by their university supervisors and cooperating teachers to create improved ways of introducing new science content and designing new ways of reviewing science material (Hollingsworth, 1989).

Connections to Sociocultural Theory

This research details how two nontraditional students in an elementary teacher education program negotiated science teaching in the classroom. A sociocultural theoretical framework, which is designed to explain how cognitive developmental processes and learning processes are products of a given society and culture, was used to view how each woman developed her identity as a science teacher. While expectations and cultural beliefs can reflect learner's values and perspectives, they can also close a mind to accepting other ways of thinking (McQuillan, 1998). Culture can influence what people think about, the skills that they obtain, when they can participate in given activities, and who is allowed to participate in which activities (Miller, 1993).

For this research, the strategies each participant used were influenced by their beliefs about science teaching, their participation in a teacher preparation program (involving courses and interactions with a university supervisor, cooperating teacher, students), as well as their role in their family (i.e., being a parent). I also observed that the participants placed different emphasis on different kinds of communication (e.g. verbal, nonverbal), as well as employed different social interactions when teaching science (Miller, 1993). By viewing nontraditional students through a sociocultural lens, I was able to identify and understand the process by which they selected the most appropriate tools (strategy) to ensure that their students learned science in an elementary classroom.

As suggested by Rogoff (1990), a cultural apprenticeship exists between the learner and certain social agents—such as teacher preparation faculty, university supervisors, and cooperating teachers, who impart the tools required for successful science teaching. Social interactions such as language were transformed in such a way as to give the student teacher the proper tools needed to plan lessons, impart information, and problem solve (if needed) (Wertsch, 1985). With an emphasis on a pragmatic method of inquiry, learning becomes an ongoing process that incorporates socialization and self-correctiveness as new information avails itself to the learner (Dewey, 1987). The ongoing incorporation of socialization was evident for both participants as they worked closely with their university supervisor and cooperating teacher. Moreover, socialization between the student teacher and her students was also an important factor when it came to lesson design and strategy selection used to teach science. Self-correctiveness was evident as both Samantha and Sarah reflected on the success of each lesson and described how they would alter the lesson if taught again.

Dewey (1987) discussed how experiences help to form a learner's thinking. As supported by this investigation's findings, nontraditional student teachers rely on prior knowledge and beliefs, as well as a variety of experiences, when selecting strategies to teach science. While Vygotsky (1978, 1986) focused more on the learner's cultural experiences, this research found that life experiences and beliefs were influential in determining the strategies nontraditional students selected to teach science. Vygotsky took into consideration how the social and cultural aspects of the educational process are intertwined. The tools and artifacts used by these student teachers influenced their cognitive processes as they went about conducting their classroom activities. As nontraditional student teachers develop their cognitive structures, they are able to incorporate these tools as they develop and teach lessons, as well as interact with supervisory personnel.

Vygotskian theory also takes into consideration how social interactions, such as between parent and child, or teacher and student, influence cognitive activity. With this in mind, this study confirmed that the interactions between the two nontraditional students and their family members were vital in informing the strategies they selected to teach elementary school science. For instance, Samantha described how her young daughter influenced her thoughts on safety and being more efficient with her instructional time. Sarah, also a mother, referenced her son as one of the factors in selecting certain teaching strategies that she thought he would like (e.g. interactive activities, videos).

Mountain View University's teacher preparation program provides many opportunities for social engagement, and its instructors played a pivotal role in helping students develop the necessary cognitive structures and skills. Vygotsky (1986) discussed how social interactions carried out by the learner are key in the learner developing an understanding of new material. Both Samantha and Sarah, for example, were part of a student teacher cohort at their assigned school; this experience gave them the opportunity to work with other student teachers to discuss science lesson plans and engage in meaningful student interactions. As the nontraditional student teachers gained knowledge by engaging in social interactions, they were able to contextualize it as they reflected upon their science lessons.

Field experiences gave both pre-service teachers an opportunity to work with experienced teachers and university supervisors. Lave and Wenger (1991) discussed the idea of peripheral participation when referring to skill-building apprenticeships such as student teaching. Lortie (1975) referred to an experience like student teaching as an apprenticeship of observation. During student teaching, Samantha and Sarah spend time working with cooperating classroom teachers as apprentices. As Samantha worked with her university supervisor, she spoke of being able include more reading strategies into her science lessons while her cooperating teacher helped her to see the benefits of using more interactive notebook activities for teaching science. It was Sarah's cooperating teacher who worked with her to implement the interactive notes within her science lessons.

Identity

As each participant negotiated the teaching of science, their multiples identities as a student, teacher, and mother influenced her selection of pedagogical strategies. The data from the participant interviews and pre- and post-classroom observation questions supports Merrill (1999) in that identity is a function of both external and internal factors; in short, their identity development was shaped by their social, institutional, and personal experiences. Additionally, the individual participant interviews support the findings of Castells (1997) and Merrill and González-Monteagudo (2010) that identity formation is an ongoing, active process that is shaped by one's culture and choice of social engagement.

As nontraditional pre-service teachers experience changes in their identity, they can experience stress. Sandler (1999) found that if nontraditional students had limited resources and higher perceived stress, they were less likely to complete a degree. Despite having limited funds and receiving financial assistance in the form of loans, Samantha and Sarah both finished their student teaching. Like many other nontraditional students—and particular those who are more mature—the two women were able to successfully negotiate the identity interchange that occurs between school (student) and home (mother and wife). However, both participants found themselves having to be more efficient with their time, whether at school or at home.

Beijaard, Meijer, and Verloop (2004) reported that throughout life a person's identity is molded and modified during their multiple interactions with other people and surrounding environments. Based on participant interviews, both Samantha and Sarah used past experiences—coupled with interactions with university supervisors, cooperating teachers and students—to evolve as science teachers. Holland et al. (1998) spoke of how the identity of a student teacher enrolled in a teacher education program is also molded by program activities such as course projects and field experiences. During her pre-classroom observation interview, Samantha commented on how her teacher preparation courses prepared her to differentiate her science instruction. Sarah commented during her first interview that her methods course gave her the ability to explain difficult science concepts to her students and make science more interesting. Both participants were able to dovetail their teacher preparation program experiences with their life experience as they assumed their science teacher identities so that they were able to provide the best possible instruction for their students.

Implications of Findings

The implications of this research for the practice of nontraditional pre-service teachers, teacher educators, teacher preparation programs and elementary school science in relation to sociocultural theory are discussed below. After discussing the implications of this study, several suggestions are proposed for future research.

Nontraditional Pre-Service Teachers

As described in Chapter One, nontraditional students are characterized as having many life experiences and a diverse knowledge base (Knowles, 1998, 1990) to draw from as students. Given their multiple responsibilities, nontraditional students bring a variety of experiences that can influence how they teach in the elementary classroom. With some of these experiences unique to nontraditional students (e.g., parent or spouse), nontraditional pre-service teachers are able to draw upon a wider experience base when selecting strategies to teach science. As described in this study, nontraditional student teachers have an advantage in that they can incorporate diverse life experiences and multiple identities into their burgeoning role as a new teacher. In particular, nontraditional students who are parents are able to draw upon that identity when considering strategies to use in teaching science.

Based on the scholarly literature, nontraditional undergraduate students tend to prefer more hands-on experience (Sheehan, 1992). In this study, both Samantha and Sarah indicated that they preferred to incorporate more hands-on instruction into their teaching strategies. Further, the perceptions of student teachers regarding teaching competencies tend to be influenced by the teaching styles and methods implemented by their own childhood teachers (Frank, 1990; Fulton, 1989; Goodland, 1990; Handler, 1993). A teacher must not only be knowledgeable about the subject matter, but must also have an understanding of society's needs and how a focused education can help fill those needs. Having more life experiences—whether as a parent, spouse, or employee—can provide nontraditional students entering postsecondary education with different perspectives on learning that they can use to their advantage.

Teacher Educators

Teacher preparation programs that include nontraditional students need to accommodate this cohort's differing expectations, skills, and abilities (Bean & Metzner, 1985; Pelletier, 2010). Specifically, it would beneficial for teacher preparation programs to consider the backgrounds, developmental processes, and the context and methodology of nontraditional student learning to develop more effective approaches to working with nontraditional pre-service teachers (Cupp, 1991). In teacher education programs, pre-service teachers are continuously revisiting their beliefs and assumptions about learning, knowledge, and teaching; thus, their prior beliefs and experiences can influence how they assimilate new information relating to teaching and learning (Carter, 1990). Focusing on science, teacher preparation programs should consider emphasizing the use of a variety of strategies to teach science.

Because the number of nontraditional students attending postsecondary schools is steadily increasing, teacher educators must become familiar with the needs, skills, and potential contributions of their diverse classroom population. Additionally, Leonard (2002) noted that nontraditional students may have more psychological or interpersonal baggage due to their life experiences and responsibilities. Therefore, it is important that teacher educators develop strategies to work with nontraditional students who may have to deal with unforeseen circumstances or juggle multiple roles. Research also shows that pre-service teachers may lack confidence in their ability to teach science; in response, teacher educators must find a way to develop a more confident student that is not intimidated by science (Baldauf & Hill, 2003, 2004). Teacher educators must consider the life experiences of their pre-service teacher population and their varied science experiences. People develop their self-efficacy based on personal life experiences. Bandura (1977) discussed how people form generalized expectancies based on life experiences, which can then influence an instructor's effectiveness in teaching science. Many teachers express a lack of confidence and low self-efficacy with regards to teaching science (Mulholland & Wallace, 2000; Appleton, 2003; Mulholland, Dorman & Odgers, 2004). When designing science courses, teacher educators have an opportunity to build the confidence and science knowledge base of their nontraditional pre-service by using a variety of methods.

If students are to become more scientifically literate and able to engage in investigative science, K-12 pre-service teachers must be well trained and able to incorporate a diverse set of skills in their elementary science classrooms. Pre-service teachers need to develop a sound understanding of pedagogical content knowledge and inquiry-based learning so they are able to provide better examples, explanations and demonstrations to help their students in understanding new material and make connections with their prior knowledge. The literature confirms that when pre-service teachers experience inquiry-based learning, their positive self-perceptions of science and their confidence in teaching science improves (Appleton, 1997; Black, 2006; Windschitl & Thompson, 2006; Zembylas & Barker, 2002). This finding reinforces the urgency for teacher preparation programs to include more hands-on, inquiry-based science experiences for their students.

Elementary School Science

Elementary school science success is based on the teacher's ability to select strategies that are engaging for all learners. As Sarah noted: "There were kids who could not sit and just listen. They needed those activities…labs. They needed to get up and move around and do the wind stuff outside" (Sarah transcript 2, p. 4, lines 77-80, 4/11/13). Sarah found that a variety of strategies worked best for her science instruction, especially group work and inquiry-based activities. Both Samantha's and Sarah's students were more excited about learning science when interactive strategies were employed.

Researchers have indicated that many elementary teachers experience difficulties in teaching science; therefore, it is critical that classroom teachers reevaluate how science is being taught (Mulholland & Wallace, 2000; Appleton, 2003; Mulholland, Dorman, & Odgers, 2004). Like the proverbial dog that can smell fear, students can sense when a teacher is not fully invested in his or her lesson and thus are less likely to be receptive to learning. Therefore, the elementary classroom teacher needs to keep a constant check on his or her "science disposition" (Seymour, 1995). For Sarah, it was building her students' confidence in doing science. Even though science was not her favorite subject, Sarah knew how important her attitude was in helping her students overcome their negative attitudes toward science. Teachers have a strong influence on a student's attitude toward science (Westerback, 1982). Problems arise when elementary teachers feel inadequate to teach science and experience high levels of anxiety associated with poor academic performance; this tends to have the unwanted outcome of science lessons that are less inquiry-based (Westerback, 1989). If American classrooms are expected to meet national and state standards by educating students who are capable of thinking critically about science, elementary classroom science lessons must include interactive science learning. Like Samantha and Sarah, teachers have to be willing to put aside their own anxieties relating to science for the benefit of their students.

In conclusion, how science is perceived by elementary students is related to the strategies used by the classroom teacher. As indicated by this investigation, nontraditional pre-service science teachers select pedagogical strategies that are influenced by a variety of factors such as prior beliefs about science teaching, experiences in teacher preparation program, and family. Add to that list the individualized needs of each student. For successful classroom science instruction, elementary classroom teachers need to know and understand the needs of their students. Regardless of their personal feelings related to science, elementary classroom teachers must be willing to select strategies that take into account the diverse skills and backgrounds of their students. And given that elementary students are more concrete learners, most educational scholars agree that science should be more interactive and inquiry-based (Dewey, 1987; Vygotsky, 1978, 1986).

Future Research

Although this study's findings confirmed that "one size does not fit all" when it comes to teacher training programs and the increasingly diverse populations they are intended to serve, more research is needed with respect to preparing nontraditional student teachers to teach science. In particular, prior beliefs of pre-service teachers are potentially limiting (Anderson et al., 1995) and "may not be well adapted to teaching" (Calderhead, 1991, p. 532). Similarly, Kagan (1992) argued that teacher beliefs are highly resistant to change and more reflective of the nature of instruction provided by the teacher. Acting as a filter, prior beliefs can greatly influence how other instructional material is interpreted. The information delivered in teacher education program courses and classroom observations are subject to interpretation, and thus can be easily misconstrued (Kagan). This research only identified how prior beliefs influenced each participant's thoughts relating to science teaching. To understand more fully how the prior beliefs of nontraditional student teachers serve as filters when it comes to understanding science, additional research should be conducted.

Calderhead (1988) discussed how pre-service teachers enter college with a general notion of what constitutes an ideal teacher, which is based on their prior classroom teachers. Lortie (1975) refers to this type of profiling as an "apprenticeship of observation" (p. 65). As nontraditional pre-service teachers draw upon their existing identities and funds of knowledge to develop as elementary classroom science teachers, it would be worth pursuing further research to understand the interactions between cooperating teachers and their nontraditional students teachers (Tan & Barton, 2007).

In conclusion, teachers need to include a variety of strategies when teaching science. As both Samantha and Sarah indicated, their teacher preparation programs were extremely helpful in suggesting pedagogical strategies for teaching science. And while the literature is rich with respect to the training of traditional pre-service science teachers, educational researchers have paid far less attention to the various factors that influence the training of nontraditional pre-service teachers—and particularly with respect to the impact of life experiences and established personal beliefs on science teaching. This population brings potentially powerful skills and knowledge to the table. Future research should continue to investigate how those advantages can be maximized to the benefit of K-12 science students.

Limitations of the Study

There are a number of limitations related to this study. First, this study focused on nontraditional elementary student teachers and the influences that affected the strategies they selected in teaching science. Therefore, these findings may not be generalizable to nontraditional middle school student teachers or nontraditional high school student teachers.

Second, this study examined the instructional strategies of two nontraditional elementary student teachers. In accordance with guidelines for conducting a qualitative study as described in Chapter Three, I relied on input from university faculty in selecting two participants. Samantha was a 23-year-old mother of an 18-month-old, while Sarah was a 42-year-old mother of a sixth grader. Their difference in age, as well as the duration of being a mother, may have impacted their selection of strategies used to teach science. By being older and having an older child, Sarah's life experiences gave her greater access to different approaches when teaching science.

A third limitation involves the number of participants. This study only followed two nontraditional student teachers. Granted, while the size sampled was small, it is not uncommon in qualitative studies. Even though this study relied on the perspectives of just two participants, the resulting data still provides insights into how beliefs about science teaching, life experiences, and teacher preparation programs influence the strategies that nontraditional student teachers select in teaching science.

A possible fourth limitation relates to the influences affecting the strategies selected used to teach science. Both schools where the participants were student teaching were located in regions with higher percentages of children in poverty; thus, the two school divisions had limited funds for purchasing science supplies. The diminished classroom resources could be considered a limiting factor in the selection of activities selected to teach science.

A fifth limitation relates to the transferability of the data collected. Given that both participants were student teaching in school divisions with higher percentages of children living in poverty, this study's data may not transferable to nontraditional student teachers in school divisions with lower poverty rates or private schools. In short, it is possible that a school's financial resources and community support may affect the strategies used to teach science.

Sixth, the two nontraditional students were completing their student teaching field experience at two separate schools, working with two different grades, and with different university supervisors. As noted in Chapter Three, Samantha was student teaching in a second grade classroom in which 9 of the 15 students were reading below grade level. In contrast, Sarah was teaching in a sixth grader classroom with only one student identified as learning disabled. Given the differences in grade level and student ability, either or both could have affected the types of strategies used to teach science.

Even though I did not assist in the teaching of the science lesson, the participants knew that I was a proponent of inquiry-based learning. This knowledge may have influenced how the participants designed their science lessons. As a classroom observer, I hoped to obtain more authentic data related to the strategies used to teach science. The pre- and post-observation interview questions afforded greater access to the influences, thoughts and evaluations of the student teachers relating to the strategies used to teach science. After each classroom observation, I found that the participants wanted to talk about their science lessons—especially telling me what they thought didn't go well. As teachers, we always want to present the best lessons possible as well as improve our craft. While both participants appeared to be totally candid and open during interviews and classroom observations, it must be noted that this study presents subjective results. Nonetheless, it is possible that Samantha or Sarah told me what they thought I wanted to hear—or were less forthcoming or open for any number of reasons. Therefore, this qualitative research bias represents another limitation to this study's findings.

Conclusion

This investigation utilized a socio-cultural theory lens with an identity-in-practice focus to look at the influence of beliefs, life experiences, and teacher preparation programs on the identity development of two nontraditional female students as elementary school science teachers. Socio-cultural theory employs a view of human development that facilitated a more systematic understanding of how science strategy selection develops out of social interactions. By understanding the participants' social influences (e.g., being a parent, having apprenticeship opportunities), I was able to link those factors to the strategies they used to teach science. In other words, learning is embedded within social events and occurred as these nontraditional pre-service teachers interacted with people and events around them. Through these social interactions, the nontraditional pre-service teachers were able to enhance their identities (e.g., student, parent, and teacher), which they drew upon as they selected strategies to teach science.

These results are based on my interpretations and are reported as such. I formulated these findings thanks to two nontraditional pre-service student teachers who were willing to share a part of their life stories with me and open up their science classroom to me. As noted earlier, this investigation represents the beginning of an important conversation about how identity influences nontraditional student teachers in the selection of strategies used to teach science in the elementary classroom.

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APPENDIX A VIRGINIA TECH IRB FORM

Once complete, upload this form as a Word document to the IRB Protocol Management System: https://secure.research.vt.edu/irb

Section 1: General Information

1.1 DO ANY OF THE INVESTIGATORS OF THIS PROJECT HAVE A REPORTABLE CONFLICT OF INTEREST?
(http://www.irb.vt.edu/pages/researchers.htm#conflict)

No
Yes, explain:

1.2 WILL THIS RESEARCH INVOLVE COLLABORATION WITH ANOTHER INSTITUTION?

No, go to question 1.3
Yes, answer questions within table

IF YES
Provide the name of the institution [for institutions located overseas, please also provide name of country]**:**
Indicate the status of this research project with the other institution's IRB: Pending approval Approved Other institution does not have a human subject protections review board Other, explain:
Will the collaborating institution(s) be engaged in the research? (http://www.hhs.gov/ohrp/humansubjects/guidance/engage08.html) No Yes
Will Virginia Tech's IRB review all human subject research activities involved with this project? No, provide the name of the primary institution: Yes *Note: primary institution = primary recipient of the grant or main coordinating center*

1.3 IS THIS RESEARCH FUNDED?

No, go to question 1.4

Yes, answer questions within table

IF YES
Provide the name of the sponsor [if NIH, specify department]:
Is this project receiving federal funds? No Yes **If yes,** **Does the grant application, OSP proposal, or "statement of work" related to this project include activities involving human subjects that are <u>not</u> covered within this IRB application?** No, all human subject activities are covered in this IRB application Yes, however these activities will be covered in future VT IRB applications, these activities include: Yes, however these activities have been covered in past VT IRB applications, the IRB number(s) are as follows: Yes, however these activities have been or will be reviewed by another institution's IRB, the name of this institution is as follows: Other, explain: **Is Virginia Tech the primary awardee or the coordinating center of this grant?** No, provide the name of the primary institution: Yes

1.4 DOES THIS STUDY INVOLVE CONFIDENTIAL OR PROPRIETARY INFORMATION (OTHER THAN HUMAN SUBJECT CONFIDENTIAL INFORMATION), OR INFORMATION RESTRICTED FOR NATIONAL SECURITY OR OTHER REASONS BY A U.S. GOVERNMENT AGENCY?
For example – government / industry proprietary or confidential trade secret information

No
Yes, describe:

1.5 DOES THIS STUDY INVOLVE SHIPPING ANY TANGIBLE ITEM, BIOLOGICAL OR SELECT AGENT OUTSIDE THE U.S?

No
Yes

Section 2: Justification
APPENDIX A VIRGINIA TECH IRB FORM

Once complete, upload this form as a Word document to the IRB Protocol Management System: https://secure.research.vt.edu/irb

Section 1: General Information

1.1 DO ANY OF THE INVESTIGATORS OF THIS PROJECT HAVE A REPORTABLE CONFLICT OF INTEREST?
(http://www.irb.vt.edu/pages/researchers.htm#conflict)

No
Yes, explain:

1.2 WILL THIS RESEARCH INVOLVE COLLABORATION WITH ANOTHER INSTITUTION?

No, go to question 1.3
Yes, answer questions within table

IF YES
Provide the name of the institution [for institutions located overseas, please also provide name of country]**:**
Indicate the status of this research project with the other institution's IRB: Pending approval Approved Other institution does not have a human subject protections review board Other, explain:
Will the collaborating institution(s) be engaged in the research? (http://www.hhs.gov/ohrp/humansubjects/guidance/engage08.html) No Yes
Will Virginia Tech's IRB review all human subject research activities involved with this project? No, provide the name of the primary institution: Yes *Note: primary institution = primary recipient of the grant or main coordinating center*

1.3 IS THIS RESEARCH FUNDED?

No, go to question 1.4
Yes, answer questions within table

IF YES
Provide the name of the sponsor [if NIH, specify department]:
Is this project receiving federal funds? No Yes **If yes,** **Does the grant application, OSP proposal, or "statement of work" related to this project include activities involving human subjects that are <u>not</u> covered within this IRB application?** No, all human subject activities are covered in this IRB application Yes, however these activities will be covered in future VT IRB applications, these activities include: Yes, however these activities have been covered in past VT IRB applications, the IRB number(s) are as follows: Yes, however these activities have been or will be reviewed by another institution's IRB, the name of this institution is as follows: Other, explain: **Is Virginia Tech the primary awardee or the coordinating center of this grant?** No, provide the name of the primary institution: Yes

1.4 DOES THIS STUDY INVOLVE CONFIDENTIAL OR PROPRIETARY INFORMATION (OTHER THAN HUMAN SUBJECT CONFIDENTIAL INFORMATION), OR INFORMATION RESTRICTED FOR NATIONAL SECURITY OR OTHER REASONS BY A U.S. GOVERNMENT AGENCY?
For example – government / industry proprietary or confidential trade secret information

No
Yes, describe:

1.5 DOES THIS STUDY INVOLVE SHIPPING ANY TANGIBLE ITEM, BIOLOGICAL OR SELECT AGENT OUTSIDE THE U.S?

No
Yes

Section 2: Justification

2.1 DESCRIBE THE BACKGROUND, PURPOSE, AND ANTICIPATED FINDINGS OF THIS STUDY:

After examining the literature relating to nontraditional elementary pre-service teachers, it is evident that the current college population is becoming more diverse, especially as it relates to age. The current trend noticed by colleges is that one third to one half of all college students are classified as nontraditional (Aslanian & Brickell, 1980). Thus, according to Brazziel (1989) nontraditional adults are considered the fastest-growing subgroup with the higher education population. Since 1989, the proportion of the nontraditional students enrolled in higher education now comprises more than 40% of the higher education population (NCES, 1990). In 2003 about 58% of the nontraditional college students were women and two-thirds of the women were 35 and older (U.S. Census 2003). This raises the question of how do nontraditional students who are returning to college find success in postsecondary teacher education.

The literature also suggests that nontraditional students enter the college classroom with a variety of prior beliefs that are reflective of how they learn (Hollingsworth, 1989). Often times those prior beliefs can influence how a student forms new understandings as it relates to science. It stands to reason that if prior beliefs held by pre-service teachers go unaddressed, barriers can form which can directly affect their classroom instruction (Anderson et al., 1995; Kagan, 1992; 1996; Slotta et al., 1995). As nontraditional pre-service teachers progress through their program of studies, it is critical that course instructors understand how influential prior beliefs are in the assimilation of knowledge. Many nontraditional students find learning more challenging due to their prior beliefs and the time spent away from academia. In particular, women who return to college to become a teacher have a lower self-efficacy when it comes to teaching science (Hadden, 1982; Levin & Jones, 1983). If a stronger efficacy is not developed in the classroom for working in the science field or teaching science, then nontraditional students who return to college are more likely to not major in science or become a science teacher. Nontraditional pre-service teachers may allow their low self-efficacy to influence lessons prepared for science instruction. Another question that this data raises is how does a teacher preparation program influence the approach nontraditional pre-service teachers and nontraditional graduates use in teaching science. In addition to their teacher preparation program, are there other influences that affect their approach to teaching science?

A case study approach will be used to provide a more detailed view of two nontraditional elementary teacher program students as they transition from the academic classroom to the elementary classroom. This ethnographic study will also analyze the science practices incorporated by the participants as a means to understand their beliefs about science and what influences the strategies selected to present science concepts. The aims of this study are to explore: a) the beliefs held by nontraditional elementary pre-service teachers and nontraditional elementary teacher program graduates relating to the teaching of science; b) how the participants were influenced by their teacher preparation program in science; and c) other influences on their development as elementary science teachers. Findings from this study will provide insights on the beliefs held by nontraditional elementary teacher program students relating to science and the teaching of science. This study will also provide data on how the participants experience being a nontraditional

students in an undergraduate elementary teacher program.

2.2 EXPLAIN WHAT THE RESEARCH TEAM PLANS TO DO WITH THE STUDY RESULTS:

For example - publish or use for dissertation

The study results will be used for dissertation. The results will also be presented at local and national conferences as well as being included in publications.

Section 3: Recruitment

3.1 DESCRIBE THE SUBJECT POOL, INCLUDING INCLUSION AND EXCLUSION CRITERIA AND NUMBER OF SUBJECTS:

Examples of inclusion/exclusion criteria - gender, age, health status, ethnicity

Two nontraditional students of Radford University's elementary teacher program will be invited to participate.

3.2 WILL EXISTING RECORDS BE USED TO IDENTIFY AND CONTACT / RECRUIT SUBJECTS?

Examples of existing records - directories, class roster, university records, educational records

No, go to question 3.3
Yes, answer questions within table

IF YES
Are these records private or public? Public Private, describe the researcher’s privilege to the records:
Will student, faculty, and/or staff records or contact information be requested from the University? No Yes, visit the following link for further information: http://www.policies.vt.edu/index.php (policy no. 2010)

3.3 DESCRIBE RECRUITMENT METHODS, INCLUDING HOW THE STUDY WILL BE ADVERTISED OR INTRODUCED TO SUBJECTS:

Two current nontraditional students of Radford University's elementary teacher program

will be asked to participate in this study. The two participants will be informed in person that a graduate student (student investigator) will be conducting participant interviews, home visits, and classroom science lesson observations to understand how they are negotiating the teaching of science in the classroom. The participants will also be told that this study will explore a) the beliefs held by nontraditional elementary teachers relating to science and the teaching of science; b) how the participants were influenced by their teacher preparation program in science; and c) other influences on their development as elementary science teachers.

3.4 PROVIDE AN EXPLANATION FOR CHOOSING THIS POPULATION:
Note: the IRB must ensure that the risks and benefits of participating in a study are distributed equitably among the general population and that a specific population is not targeted because of ease of recruitment.

In order to investigate the science beliefs held and the science teaching experiences of nontraditional students of an elementary teacher program, I will need to select participants who meet the following criteria: a male or female nontraditional elementary teacher program student

Section 4: Consent Process

For more information about consent process and consent forms visit the following link: http://www.irb.vt.edu/pages/consent.htm

If feasible, researchers are advised and may be required to obtain signed consent from each participant unless obtaining signatures leads to an increase of risk (e.g., the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting in a breach of confidentiality). Signed consent is typically not required for low risk questionnaires (consent is implied) unless audio/video recording or an in-person interview is involved. If researchers will not be obtaining signed consent, participants must, in most cases, be supplied with consent information in a different format (e.g., in recruitment document, at the beginning of survey instrument, read to participant over the phone, information sheet physically or verbally provided to participant).

4.1 CHECK ALL OF THE FOLLOWING THAT APPLY TO THIS STUDY'S CONSENT PROCESS:

Verbal consent will be obtained from participants
X Written/signed consent will be obtained from participants
Consent will be implied from the return of completed questionnaire. Note: The IRB recommends providing consent information in a recruitment document or at the beginning of the questionnaire (if the study only involves implied consent, skip to Section 5 below)
Other, describe:

4.2 PROVIDE A GENERAL DESCRIPTION OF THE PROCESS THE RESEARCH TEAM WILL USE TO OBTAIN AND MAINTAIN INFORMED CONSENT:

The graduate student (student investigator) will meet with each participant separately in the office of the graduate student. The pre-service teachers who are selected will be provided with a copy of the Student Informed Consent by the graduate student (student investigator). The researcher will read the Informed Consent form out loud to each participating individual and will answer any questions that the participant may have. Informed Consent Forms will be collected and retained by the Primary Investigator in a secure location.

4.3 WHO, FROM THE RESEARCH TEAM, WILL BE OVERSEEING THE PROCESS AND OBTAINING CONSENT FROM SUBJECTS?

The student investigator will distribute and collect the consent forms from the subjects. The consent forms will be given to the Principle Investigator, Dr. George Glasson, who will over see the data collection and analysis to ensure that no data is used from the participants who have not signed a consent form.

4.4 WHERE WILL THE CONSENT PROCESS TAKE PLACE?

In the office of the graduate student at Radford University.

4.5 DURING WHAT POINT IN THE STUDY PROCESS WILL CONSENTING OCCUR?
Note: unless waived by the IRB, participants must be consented before completing any study procedure, including screening questionnaires.

The consent process will occur prior to any data collected.

4.6 IF APPLICABLE, DESCRIBE HOW THE RESEARCHERS WILL GIVE SUBJECTS AMPLE TIME TO REVIEW THE CONSENT DOCUMENT BEFORE SIGNING:
Note: typically applicable for complex studies, studies involving more than one session, or studies involving more of a risk to subjects.

The participants will be presented with the Informed Consent Form in the office of the graduate student (student investigator) prior to data being collected. The graduate student (student investigator) will read the consent form to the participant and will answer any questions. The participants will be given up to one week to consider their participation.

Not applicable

Section 5: Procedures

5.1 PROVIDE A STEP-BY-STEP THOROUGH EXPLANATION OF ALL STUDY PROCEDURES EXPECTED FROM STUDY PARTICIPANTS, INCLUDING TIME COMMITMENT & LOCATION:

Participants will be expected to participate in structured interviews and classroom science observations. Each participant will be asked to complete two separate forty-five minute interviews on dates to be determined by the graduate student (student investigator) and the participant. Interviews will be conducted at a location that is private and convenient for the participant at designated times. The participants will allow the graduate student (student investigator) to observe them teaching 5 science lessons. Prior to the lesson being taught the participant will be interviewed on the lesson that will be observed. After each lesson the participants will be interviewed again on the science lesson observed. Each participant will allow the graduate student (student researcher) access to classroom artifacts such as lesson plans and worksheets used during the classroom observations.

5.2 DESCRIBE HOW DATA WILL BE COLLECTED AND RECORDED:

The study will involve the collection of: A. tape recording of interviews with teacher participants B. transcripts of all interviews with teacher participants C. paper copy of classroom artifacts used such as lesson plans and worksheets D. paper copy of classroom science observations

5.3 DOES THE PROJECT INVOLVE ONLINE RESEARCH ACTIVITES (INCLUDES ENROLLMENT, RECRUITMENT, SURVEYS)?
View the "Policy for Online Research Data Collection Activities Involving Human Subjects" at http://www.irb.vt.edu/documents/onlinepolicy.pdf

No, go to question 6.1
Yes, answer questions within tab

IF YES
Identify the service / program that will be used: www.survey.vt.edu, go to question 6.1 Blackboard, go to question 6.1 Center for Survey Research, go to question 6.1 Other **IF OTHER:** Name of service / program: URL: This service is… Included on the list found at: http://www.irb.vt.edu/pages/validated.htm Approved by VT IT Security An external service with proper SSL or similar encryption

(https://) on the login (if applicable) and all other data collection pages.
None of the above (note: only permissible if this is a collaborative project in which VT individuals are only responsible for data analysis, consulting, or recruitment)

Section 6: Risks and Benefits

6.1 WHAT ARE THE POTENTIAL RISKS (E.G., EMOTIONAL, PHYSICAL, SOCIAL, LEGAL, ECONOMIC, OR DIGNITY) TO STUDY PARTICIPANTS?

There are minimal risks to the participants in this study. The risks to the participants are no greater than the risks associated with normal classroom teaching.

6.2 EXPLAIN THE STUDY'S EFFORTS TO REDUCE POTENTIAL RISKS TO SUBJECTS:

The participants will be able to choose if they are going to participate or not. Participation will in no way affect their classroom teaching or academic performance as a student. Each participant will have a pseudonym assigned. The location of their school, and institution from which they attend will also be identified by a pseudonym. If there are any concerns about individual confidentiality or if questions arise about the study, the Primary Investigator will be contacted and consulted. All of the original data collected during the study will be stored in a safe location by the Primary Investigator. The participants also have the right to withdraw from participation at any time by notifying the researchers in writing of the desire to withdraw.

6.3 WHAT ARE THE DIRECT OR INDIRECT ANTICIPATED BENEFITS TO STUDY PARTICIPANTS AND/OR SOCIETY?

There are no direct benefits to the teachers for participation in this study. No promises or guarantees of benefits will be made to encourage participation. Indirect benefits may include ideas for classroom science adjustments that would help better facilitate science learning for the participant's classroom students. The results of this study could provide valuable insights as to what supports nontraditional preservice teachers need in order to find success within the elementary education program. Furthermore, the findings from this study will reveal how nontraditional students of an elementary teacher education program frame their thinking as teachers as well as the influences affecting their teacher identity formation. As part of the findings, this research will provide insights on the beliefs held by nontraditional students of an elementary teacher program relating to science and the teaching of science. The proposed research will also provide data on how the participants were influenced by their teacher preparation program in science; and c) other influences on their development as elementary science teachers.

Section 7: Full Board Assessment

7.1 DOES THE RESEARCH INVOLVE MICROWAVES/X-RAYS, OR GENERAL ANESTHESIA OR SEDATION?

No
Yes

7.2 DO RESEARCH ACTIVITIES INVOLVE PRISONERS, PREGNANT WOMEN, FETUSES, HUMAN IN VITRO FERTILIZATION, OR MENTALLY DISABLED PERSONS?

No, go to question 7.3
Yes, answer questions within table

IF YES
This research involves: Prisoners Pregnant women Fetuses Human in vitro fertilization Mentally disabled persons

7.3 DOES THIS STUDY INVOLVE MORE THAN MINIMAL RISK TO STUDY PARTICIPANTS?

Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily activities or during the performance of routine physical or psychological examinations or tests. Examples of research involving greater than minimal risk include collecting data about abuse or illegal activities. Note: if the project qualifies for Exempt review (http://www.irb.vt.edu/pages/categories.htm), it will not need to go to the Full Board.

No
Yes

IF YOU ANSWERED "YES" TO ***ANY ONE*** OF THE ABOVE QUESTIONS, 7.1, 7.2, OR 7.3, THE BOARD MAY REVIEW THE PROJECT'S APPLICATION MATERIALS AT ITS MONTHLY MEETING. VIEW THE FOLLOWING LINK FOR DEADLINES AND ADDITIONAL INFORMATION: http://www.irb.vt.edu/pages/deadlines.htm

Section 8: Confidentiality / Anonymity

For more information about confidentiality and anonymity visit the following link: http://www.irb.vt.edu/pages/confidentiality.htm

8.1 WILL PERSONALLY IDENTIFYING STUDY RESULTS OR DATA BE RELEASED TO ANYONE OUTSIDE OF THE RESEARCH TEAM?

For example – to the funding agency or outside data analyst, or participants identified in publications with individual consent

No
Yes, to whom will identifying data be released?

8.2 WILL ANY STUDY FILES CONTAIN PARTICIPANT IDENTIFYING INFORMATION (E.G., NAME, CONTACT INFORMATION, VIDEO/AUDIO RECORDINGS)?

Note: if collecting signatures on a consent form, select "Yes."

No, go to question 8.3
Yes, answer questions within table

IF YES
Describe if/how the study will utilize study codes: Pseudonyms will be assigned to each student. No one outside of the research team will have access to the actual names associated with the pseudonyms.
If applicable, where will the key [i.e., linked code and identifying information document (for instance, John Doe = study ID 001)] **be stored and who will have access?** The identifying information will be stored in a folder and locked in file cabinet in the Primary Investigator's office at Radford University. Only the Primary Investigator will have access to the locked file cabinet. *Note: the key should be stored separately from subjects' completed data documents and accessibility should be limited.*
The IRB strongly suggests and may require that all data documents (e.g., questionnaire responses, interview responses, etc.) do not include or request identifying information (e.g., name, contact information, etc.) from participants. If you need to link subjects' identifying information to subjects' data documents, use a study ID/code on all data documents.

8.3 WHERE WILL DATA BE STORED?

Examples of data - questionnaire, interview responses, downloaded online survey data, observation recordings, biological samples

Data documents will be stored in a folder, which will be in a different locked file cabinet in the Primary Investigator's office at Radford University.

8.4 WHO WILL HAVE ACCESS TO STUDY DATA?

Only the researchers with the project will have access to the data.

8.5 DESCRIBE THE PLANS FOR RETAINING OR DESTROYING THE STUDY DATA

All data, including the tape recordings of the participant interviews will be retained for a period of not more than five years in a secure location under the supervision of the Primary Investigator. After that time, the tape recordings will be erased. In addition tape recordings being erased, all other data collected during the study will also be destroyed by shredding it.

8.6 DOES THIS STUDY REQUEST INFORMATION FROM PARTICIPANTS REGARDING ILLEGAL BEHAVIOR?

No, go to question 9.1
Yes, answer questions within table

IF YES
Does the study plan to obtain a Certificate of Confidentiality? No Yes (Note: participants must be fully informed of the conditions of the Certificate of Confidentiality within the consent process and form) *For more information about Certificates of Confidentiality, visit the following link:* *http://www.irb.vt.edu/pages/coc.htm*

Section 9: Compensation

For more information about compensating subjects, visit the following link: http://www.irb.vt.edu/pages/compensation.htm

9.1 WILL SUBJECTS BE COMPENSATED FOR THEIR PARTICIPATION?

No, go to question 10.1
Yes, answer questions within table

IF YES
What is the amount of compensation?
Will compensation be prorated? Yes, please describe: No, explain why and clarify whether subjects will receive full compensation if they withdraw from the study? *Unless justified by the researcher, compensation should be prorated based on duration of study participation. Payment must <u>not</u> be contingent upon completion of study procedures. In other words, even if the subject decides to withdraw from the study, he/she should be compensated, at least partially, based on what study procedures he/she has completed.*

Section 10: Audio / Video Recording

For more information about audio/video recording participants, visit the following link: http://www.irb.vt.edu/pages/recordings.htm

10.1 WILL YOUR STUDY INVOLVE VIDEO AND/OR AUDIO RECORDING?

No, go to question 11.1
Yes, answer questions within table

IF YES
This project involves: X Audio recordings only Video recordings only Both video and audio recordings
Provide compelling justification for the use of audio/video recording: To understand how nontraditional students were influenced by their teacher prep program in science and other possible influences on their development as elementary science teachers, the participants need to be observed actively involved in their classroom teaching science. It is not enough to conduct a survey to find out about their past science experiences or examine their lesson plans. They need to be able to tell their science story. By using an ethnographical approach, the participants will be able to express their true feelings, influences, struggles and successes with science. The use of audio recordings will allow the data gathered during the participant interview process to be more accurately recorded. This will result in a more precise transcription of the data. With the focus being on nontraditional students teaching science in the elementary classroom, audio recordings will give the participants the ability to articulate both accurate and detailed accounts of their lives. This will give researchers the opportunity to understand a) what their beliefs are about science and the teaching of

science; and b) how they were influenced by their teacher preparation program in science as well as any other influences on their development as elementary science teachers. Audio recordings will also provide multiple opportunities for the researcher to listen to each participant's interviews so that the participant's true emotions can be understood and captured in transcription.
How will data within the recordings be retrieved / transcribed? All audio recordings will be transcribed. During the initial phase of data analysis, the transcriptions of the interviews will be analyzed several times. While reviewing the transcriptions along with field notes collected, over arching themes will be recorded. As the themes develop, more detailed categories will be formed, which will allow the graduate student (primary researcher) to take the individual parts of the audio recordings and begin to form a complete story of a) the beliefs held about science and science teaching; b) how they were influenced by their teacher prep program in science; and c) any other influences on their development as elementary science teacher. The primary researcher will review the transcribed notes to check for accuracy of themes and categories. The participants will be given an opportunity to respond to the notes and to any other written work involving the participant in the study.
How and where will recordings (e.g., tapes, digital data, data backups) be stored to ensure security? The recordings will be stored in a locked file cabinet in Mrs. Mythianne Shelton's (primary investigator) office.
Who will have access to the recordings? The Principle Investigator and graduate student (student investigator) assigned to the project will have access to the recordings.
Who will transcribe the recordings? A graduate student (student investigator) will transcribe the data under the direction of the Principle Investigator.
When will the recordings be erased / destroyed? The audio recordings will be erased twelve months after the conclusion of the project.

Section 11: Research Involving Students

11.1 DOES THIS PROJECT INCLUDE STUDENTS AS PARTICIPANTS?

No, go to question 12.1
Yes, answer questions within table

IF YES
Does this study involve conducting research with students of the researcher?

No Yes, describe safeguards the study will implement to protect against coercion or undue influence for participation: *Note: if it is feasible to use students from a class of students not under the instruction of the researcher, the IRB recommends and may require doing so.*
Will the study need to access student records (e.g., SAT, GPA, or GRE scores)? No Yes

11.2 DOES THIS PROJECT INCLUDE <u>ELEMENTARY</u>, <u>JUNIOR</u>, OR <u>HIGH SCHOOL</u> STUDENTS?

No, go to question 11.3
Yes, answer questions within table

IF YES
Will study procedures be completed during school hours? No Yes **If yes,** **Students not included in the study may view other students' involvement with the research during school time as unfair. Address this issue and how the study will reduce this outcome:** **Missing out on regular class time or seeing other students participate may influence a student's decision to participate. Address how the study will reduce this outcome:**
Is the school's approval letter(s) attached to this submission? Yes No, project involves Montgomery County Public Schools (MCPS) No, explain why: *You will need to obtain school approval (if involving MCPS, click here: http://www.irb.vt.edu/pages/mcps.htm). Approval is typically granted by the superintendent, principal, and classroom teacher (in that order). Approval by an individual teacher is insufficient. School approval, in the form of a letter or a memorandum should accompany the approval request to the IRB.*

11.3 DOES THIS PROJECT INCLUDE COLLEGE STUDENTS?

No, go to question 12.1
Yes, answer questions within table

IF YES
Some college students might be minors. Indicate whether these minors will be included in the research or actively excluded: Included Actively excluded, describe how the study will ensure that minors will not be included:
Will extra credit be offered to subjects? No Yes **If yes,** **What will be offered to subjects as an equal alternative to receiving extra credit without participating in this study?** **Include a description of the extra credit (e.g., amount) to be provided within question 9.1 ("IF YES" table)**

Section 12: Research Involving Minors

12.1 DOES THIS PROJECT INVOLVE MINORS (UNDER THE AGE OF 18 IN VIRGINIA)?
Note: age constituting a minor may differ in other States.

No, go to question 13.1
Yes, answer questions within table

IF YES
Does the project reasonably pose a risk of reports of current threats of abuse and/or suicide? No Yes, thoroughly explain how the study will react to such reports: *Note: subjects and parents must be fully informed of the fact that researchers must report threats of suicide or suspected/reported abuse to the appropriate authorities within the Confidentiality section of the Consent, Assent, and/or Permission documents.*
Are you requesting a waiver of parental permission (i.e., parent uninformed of child's involvement)?

No, **both** parents/guardians will provide their permission, if possible. No, **only one** parent/guardian will provide permission. Yes, describe below how your research meets **<u>all</u>** of the following criteria (A-D): Criteria A - The research involves no more than minimal risk to the subjects: Criteria B - The waiver will not adversely affect the rights and welfare of the subjects: Criteria C - The research could not practicably be carried out without the waiver: Criteria D - (Optional) Parents will be provided with additional pertinent information after participation:
Is it possible that minor research participants will reach the legal age of consent (18 in Virginia) while enrolled in this study? No Yes, will the investigators seek and obtain the legally effective informed consent (in place of the minors' previously provided assent and parents' permission) for the now-adult subjects for any ongoing interactions with the subjects, or analysis of subjects' data? If yes, explain how: *For more information about minors reaching legal age during enrollment, visit the following link: http://www.irb.vt.edu/pages/assent.htm*
*The procedure for obtaining assent from minors and permission from the minor's guardian(s) must be described in **Section 4** (Consent Process) of this form.*

Section 13: Research Involving Deception

For more information about involving deception in research and for assistance with developing your debriefing form, visit our website at http://www.irb.vt.edu/pages/deception.htm

13.1 DOES THIS PROJECT INVOLVE DECEPTION?

No, go to question 14.1
Yes, answer questions within table

IF YES
Describe the deception:
Why is the use of deception necessary for this project?
Describe the debriefing process:
Provide an explanation of how the study meets <u>all</u> the following criteria (A-D) for an alteration of consent: Criteria A - The research involves no more than minimal risk to the subjects:

Criteria B - The alteration will not adversely affect the rights and welfare of the subjects: Criteria C - The research could not practicably be carried out without the alteration: Criteria D - (Optional) Subjects will be provided with additional pertinent information after participation (i.e., debriefing for studies involving deception): *By nature, studies involving deception cannot provide subjects with a complete description of the study during the consent process; therefore, the IRB must allow (by granting an alteration of consent) a consent process which does not include, or which alters, some or all of the elements of informed consent.*
The IRB requests that the researcher use the title "Information Sheet" instead of "Consent Form" on the document used to obtain subjects' signatures to participate in the research. This will adequately reflect the fact that the subject cannot fully consent to the research without the researcher fully disclosing the true intent of the research.

Section 14: Research Involving Existing Data

14.1 WILL THIS PROJECT INVOLVE THE COLLECTION OR STUDY/ANALYSIS OF EXISTING DATA DOCUMENTS, RECORDS, PATHOLOGICAL SPECIMENS, OR DIAGNOSTIC SPECIMENS?
Please note: it is not considered existing data if a researcher transfers to Virginia Tech from another institution and will be conducting data analysis of an on-going study.

No, you are finished with the application
Yes, answer questions within table

IF YES
From where does the existing data originate?
Provide a detailed description of the existing data that will be collected or studied/analyzed:
Is the source of the data public? No, continue with the next question Yes, you are finished with this application
Will any individual associated with this project (internal or external) have access to or be provided with existing data containing information which would enable the identification of subjects: • ♣ **Directly** (e.g., by name, phone number, address, email address, social security number, student ID number), or • ♣ **Indirectly through study codes** even if the researcher or research team does not have access to the master list linking study codes to identifiable

information such as name, student ID number, etc

or

- ♣ **Indirectly through the use of information that could reasonably be used in combination to identify an individual** (e.g., demographics)

No, collected/analyzed data will be completely de-identified
Yes,

If yes,

Research will not qualify for exempt review; therefore, if feasible, written consent must be obtained from individuals whose data will be collected / analyzed, unless this requirement is waived by the IRB.

Will written/signed or verbal consent be obtained from participants prior to the analysis of collected data?

This research protocol represents a contract between all research personnel associated with the project, the University, and federal government; therefore, must be followed accordingly and kept current.

Proposed modifications must be approved by the IRB prior to implementation except where necessary to eliminate apparent immediate hazards to the human subjects.

Do not begin human subjects activities until you receive an IRB approval letter via email.

It is the Principal Investigator's responsibility to ensure all members of the research team who collect or handle human subjects data have completed human subjects protection training prior to handling or collecting the data.

APPENDIX B INFORMED CONSENT FOR PARTICIPANTS

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants

Title of Project:
How Do Nontraditional Elementary Preservice Teachers Negotiate the Teaching Science?

Principle Investigator:
Mythianne Shelton, Graduate Student, Science Education, Virginia Tech

I. Purpose
The purpose of this research is examine how nontraditional elementary teacher program students negotiate their teaching of science in the classroom by exploring a) prior beliefs about science and the teaching of science; b) how the participants were influenced by their teacher preparation program in science; and c) other influences on their development as elementary science teachers. This study involves participating in the normal activities associated with teaching in the elementary classroom. Participants consist of two nontraditional teachers that are preservice teachers in an education at Radford University, Radford, Virginia.

II. Procedure
You are expected to participate in the two forty-five minute interviews, five classroom science lesson observations, five post classroom science lesson observation; and allow access to classroom artifacts relating to the science lesson observed. This study will involve the collection of:

A. Participant observations while teaching science lessons
B. Tape recordings of all interviews
C. Participant science lesson plans and artifacts associated with the lesson

III. Risks
There are minimal risks to participation in this study. Risks to participants are no greater than the risks associated with normal teaching in the classroom or being at home. In addition, you have the right to withdraw from participation at any time by notifying the researcher in writing or express your desire to withdraw.

IV. Benefits
There are no direct benefits to you for participation in this study. No promise or guarantee of benefits has been made to encourage you to participate. Indirect benefits may include providing a better support system for nontraditional elementary education program graduates that are mothers who have graduated from college as well as those who are currently participating in elementary education programs.

V. Extent of Anonymity and Confidentiality
The researcher will keep all data collected confidential, excepted as noted. Only the researcher and the advisor will have access to the data. Information gathered from the

study may be used in reports, presentations, and articles in professional journals. However, participant names will not be used in any report, presentation, or article and any identifying information will be changed so that data cannot be connected to participating individuals. Pseudonyms will be used. No identifying characteristics of the participants will be revealed in any reporting of the data. Despite efforts to preserve it, anonymity may be compromised.

The researcher will catalogue and code the data, including tape recordings of participant interviews. The tape recordings will then be transcribed for further analysis. Only the researcher and advisor will have access to the tapes and transcriptions of the interviews.

All data, including the tape-recorded interviews, will be retained for a period of not more than five years in secure locations under the supervision of the primary researcher. After that time, the tape recordings will be erased and the other data destroyed.

It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation
Participants will not be compensated for participating in this study.

VII. Freedom to Withdraw
Participants are free to withdraw from this study at any time without penalty. You are free to not respond to any research situations that you choose without penalty. You are free to request that any discussion transcript of you be removed from the data set without penalty. There may be circumstances under which the investigators may determine that you should not continue to be involved in the study.

VIII. Subjects' Responsibilities
I voluntarily agree to participate in the research project. I have the following responsibilities: participate in the normal classroom preparation and teaching activities, participate in two forty-five minute audio-taped interviews, five classroom science lesson observations, five post classroom science lesson observation interviews, and provide access to science lesson plans.

I hereby acknowledge the above and give my voluntary consent for the collection and analysis of the following materials (please initial all that apply):

_____ two forty-five minute interviews

_____ transcription of two forty-five minute interviews

_____ five classroom science observations

_____ five thirty minute post classroom science observation interviews

_____ transcription of five thirty minute post-classroom science observation interview

______science lesson plans

_______________________________________ _______________

Participant's Signature Date

Should I have any questions about this research or its conduct, I may contact:

Mythianne Shelton	540-831-6011	mrshelton@runet.edu
Dr. George Glasson	540-231-8346.	glassong@vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email moored@vt.edu; address: Office of Research Compliance, 2000 Kraft Drive, Suite 2000 (0497), Blacksburg, VA 2460.

You will be provided with a complete or duplicate of the original of the signed Informed Consent.