SHAPING BIRTH THROUGH KINDERGARTEN PRESERVICE TEACHERS’ SELF-EFFICACY TOWARDS TEACHING SCIENCE

by

EVELAINE GRACE PENDERGAST

(Under the Direction of Cynthia O. Vail)

ABSTRACT

The purpose of this study aimed to describe how experiences in an innovative science course with connected service learning influenced preservice birth through kindergarten teachers’ efficacy towards teaching science and how the reported influences aligned with Bandura’s four major sources of self-efficacy. The research questions that guided this study, grounded in Bandura’s social cognitive theory specifically his concept of self-efficacy, were: (a) How do preservice birth to kindergarten teachers perceive their experiences in a science course with connected service learning influence their self-efficacy towards science teaching, and (b) How do these reported influences align with Bandura’s (1997) four sources of information of self-efficacy? This qualitative descriptive case study used an interpretive research approach. Birth to kindergarten preservice teachers’ reported experiences within the science-related course and connected service learning included elements of all four sources of self-efficacy as proposed by Bandura (1997). All four sources of efficacy information were reported as salient to some degree. In addition to sources proposed by Bandura (1997), self-reflection, simulated modeling, science content and science pedagogical knowledge were also reported as valuable sources for enhancing preservice teachers’ self-efficacy towards teaching science.
INDEX WORDS: birth through kindergarten preservice teachers, prekindergarten, preschool, qualitative methods, science, service learning, self-efficacy, teacher preparation
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DEDICATION

I wish to dedicate my dissertation to those I love with all my heart -

Ma & Pa, my wonderful parents,

Vicki & La, my best friends forever,

&

Jade, my lovely daughter.
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CHAPTER 1

INTRODUCTION

Current research acknowledges children are ready and eager to learn about science skills and concepts long before they cross the kindergarten threshold (Duschl, Schweingruber, & Shouse, 2007; Gelman & Williams, 1998). Recognizing children arrive to elementary school with skills, knowledge, and dispositions that support school readiness and achievement in science has prompted considerable attention toward preschool science education (Duschl et al., 2007; Eshach, 2011, Eshach & Fried, 2005). Collaboration between the early childhood community, K-12 leaders, and policy makers has enhanced the quality of science-related early learning standards hoping to raise the likelihood that preschool science programs are successfully implemented. However, very little science learning happens in early learning settings (Brenneman, Stevenson-Boyd, & Frede, 2009; Greenfield, Jirout, Dominguez, Greenberg, Maier, & Fuccillo, 2009). Educational researchers suggest one possible link may be related to the practicum experience offered in birth through kindergarten teacher preparation programs (Zaslow, Tout, Halle, Whittaker, & Lavelle, 2010). Teacher preparation programs do not typically emphasize science content, pedagogy, or opportunities to practice teaching science (Brenneman, et al., 2009; Lobman, Ryan, & McLaughlin, 2005). Even among preschool teachers who have degrees, lack of knowledge and confidence result in little science teaching for children (Isenberg, 2000; Lobman, Ryan, & McLaughlin, 2005). A goal of birth through kindergarten teacher preparation programs should be to offer prospective teachers opportunities to learn
science content, understand how children develop science content, and to practice and apply evidence-based pedagogical techniques.

Long before attending kindergarten, children possess content knowledge that loosely links onto the scientific subjects of physics, chemistry, psychology, and biology (Brenneman, 2010, Duschl, Schweingruber, & Shouse, 2006; Nayfeld, Brenneman, & Gelman, 2011). This makes preschool classrooms ideal environments for guiding young children in their natural pursuit of knowing. Quality preschool classrooms are perfect “laboratories” explicitly designed to nurture children’s curiosity and encourage them to use their senses to observe, problem solve, think divergently, communicate, and question. When developmentally appropriate science experiences are provided, basic skills in language, literacy, and math are integrated and reinforced (Gerde, Schachter, & Wasik, 2013; Greenfield & Jirot, 2009), understanding of science concepts later in life are strengthened (Brenneman, 2010; Eshach and Fried, 2005; Gerde et al., 2013; Metz, 2009), and lifelong positive attitudes toward science and scientists are fostered (Edwards & Loveridge, 2011; Metz, 2009).

In January 2014, the National Science Teachers Association (NSTA, 2014) adopted a new position statement, the Early Childhood Science Position Statement. This document was inspired by early childhood educators looking for guidance informed by research on how to approach science teaching in the preschool years (ages 3–5) before kindergarten. Drawing on research from the National Research Council, the National Association for the Education of Young Children and others, the NSTA Position Statement on Early Childhood Science Education “… affirms that learning science and engineering practices in the early years can foster children’s curiosity and enjoyment in exploring the world around them and lay the foundation for a progression of science learning in K–12 settings and throughout their entire
The position statement encourages early childhood educators to recognize young children’s “capacity for constructing conceptual learning and the ability to use the practices of reasoning and inquiry” (NSTA, 2014, p.1) at a developmentally appropriate level. Early childhood educators are urged to “take advantage of what children do as part of their everyday life prior to entering formal school settings [because] these skills and abilities can provide helpful starting points for developing scientific reasoning” (NSTA, 2014, p.1).

An educational commitment to preschoolers as science learners is also represented in that virtually all U.S. states have developed science-related early learning standards for preschoolers. A recent Web-based search reviewing publicly available early learning standard documents identified a list of science content and topic areas and process skills that preschool children are expected to learn. The broadest content areas that emerged among states were related to inquiry and scientific thinking (77%), highlighting eight common process skills set forth in existing research (e.g., observing, describing, comparing, questioning, predicting, experimenting, reflecting, and cooperating) (Greenfield & Jirout, 2009). Three other broad content areas were life science (58%), earth and space science (56%), and physical science (58%). Georgia’s early learning science standards highlight three main content areas (life science, physical science, and earth/space science) as well as expectations that preschoolers learn critical thinking skills consistent with the eight common process skills set forth in existing literature. These standards emphasize the importance of teaching preschoolers science with the expectation that they enter kindergarten with the skills and knowledge necessary for academic success.

Despite current attitudes about the importance of supporting children’s curiosity and scientific thinking in preschool, research focused on instructional practices in early childhood education suggests that neither planned nor unplanned science activities are likely to occur in
preschool classrooms (Brenneman et al., 2009; Greenfield & Jirout, 2009). This absence has been rationalized by the predominant role language and literacy has played in early childhood curricula, teacher education, and professional development programs (Brenneman et al., 2009). A review of institutions providing early childhood teacher preparation in the state of New Jersey found 79% of the programs offered a stand-alone literacy class and only 21% required a full course in other content areas of science, math, social studies, or art (Lobman et al., 2001). A classroom observation study supported the predominance of language and literacy in preschool classrooms, reporting preschool teachers’ subject area preferences are unrelated to science (86.8%) and rarely engaged in formal (4.5%) or informal (8.8%) science instruction (Tu, 2006). In a self-report survey, when preschool teachers ranked their preferences for subject areas, they ranked Language and Literacy (45%); Aesthetic Expression (20%); Health, Safety, and Nutrition (10%); Gross Motor and Outdoors (10%); Science (5%); and Social Studies (5%) (Tu and Hsaio, 2008). In essence, science has been viewed as an “extra” rather than an essential component of the curriculum.

A second major factor significantly influencing and increasing the complexity of the situation lies with the individual teaching professionals’ beliefs toward science education. Studies that have examined scientific learning and teaching in preschool contexts have provided explanations for how preschool teachers’ beliefs and attitudes toward science affect their behavior. Preschool teachers disinclined or averse to teach science report: (a) feelings of discomfort or anxiety due to a sense of low self-efficacy, believing they will not succeed and fail (Greenfield & Jirout, 2009), (b) beliefs or misconceptions that science is a difficult content area to teach and avoid it (Yoon and Onchwari, 2006), (c) feelings that science is too hard and abstract for young children to learn, underestimating and not appreciating the foundational
knowledge preschoolers already have about science topics and the progression of learning science (Brenneman, 2010; Duschl et al., 2007; Metz, 2009), and (d) pessimistic feelings or aversions toward science from their past schooling experiences which they generalize to their subsequent science teaching (Edwards and Loveridge, 2011). These feelings of discomfort, anxiety, and aversion may be due in part to teacher preparation programs failing to integrate experiences that positively influence preservice teachers’ perceived self-efficacy beliefs towards teaching science to young children.

Over the past 25 years, teacher efficacy has emerged as an important construct in teacher education. Teacher efficacy is grounded in Bandura’s social cognitive theory (1997). As initially described in his 1977 article “Self-Efficacy: Toward a Unifying Theory of Behavioral Change,” Bandura (1977) defined perceived self-efficacy as “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (p.3). Self-efficacy is a future-oriented belief about the level of competence a person expects he or she will display in a given situation. Self-efficacy beliefs influence thought patterns and emotions that enable actions in which people expend substantial effort in pursuit of goals, persist in the face of adversity, rebound from temporary setbacks, and exercise some control over events that affect their lives (Bandura, 1997). Bandura identified two dimensions of self-efficacy: personal self-efficacy and outcome expectancy. Personal self-efficacy is the “belief in one’s capabilities to organize and execute the courses of action required to produce given attainments, whereas outcome expectancy is a judgment of the likely consequence such performances will produce” (Bandura, 1997, p. 3).

Self-efficacy has to do with self-perception of competence rather than the actual level of competence. This is an important distinction because people regularly overestimate or
underestimate their actual abilities, and these estimations may have consequences for the courses of actions they choose to pursue or the effort they exert in those pursuits. Over- or underestimating capabilities may also influence how well people use the skills they possess. Bandura (1997) asserts, “A capability is only as good as its execution. The self-assurance with which people approach and manage difficult tasks determines whether they make good or poor use of their capabilities. Insidious self-doubts can easily overrule the best of skills” (p. 35).

Bandura (1994) suggested four sources that influence self-efficacy: (a) mastery experiences, (b) vicarious experiences, (c) social persuasion, and (d) physiological and emotional states. The first source, mastery experiences, is characterized by repeated successful experiences. These successes can enhance an individual’s self-confidence and behavior and attitudes toward future challenges. The second source, vicarious experiences, is described as positive and negative encounters in social models. The experiences of seeing oneself in others and their struggles can weaken or strengthen personal perceptions of inadequacies. The third source, social persuasion, occurs through verbal affirmations and motivation within the setting. Positive affirmations and a positive classroom environment may encourage participation and convince an individual of his or her capabilities. Finally, physiological and emotional state is characterized by a reduction in stress reactions (e.g., increased heart rate, sweaty palms, butterflies in stomach) and an altering of negative emotional reactions (e.g., anxiety, staying calm). In an environment that nurtures positive emotional outcomes, individuals may freely focus and concentrate on what they are learning.

Teacher self-efficacy researchers have cautioned that teacher preparation programs focusing only on developing high quality teaching skills may not predict whether the teachers will utilize these newly acquired skills in the classroom (Chong & Kong, 2012; Siwatu, 2007;
Zeldin & Pajares, 2000). According to Bandura (1997), “perceived self-efficacy is concerned not with the number of skills you have, but with what you believe you can do with what you have under a variety of circumstances” (p. 37). Therefore, it is recommended teacher preparation programs provide prospective teachers with experiences that incorporate the learned instructional skills in actual real-life classrooms. To nurture resilient self-efficacy beliefs, these experiences need to occur frequently and integrate the four sources Bandura believed to influence the formation of these beliefs (Siwatu, 2007; 2011; Ross & Bruce, 2007). Of these four sources, mastery experiences are believed to be the most influential because they provide an individual with firsthand experiences regarding their capabilities (Bandura, 1997). However, for preservice teachers who do not have a lot of mastery experiences to draw from, the other known sources of self-efficacy information have a greater impact.

During the course of their preparation, teachers should be given opportunities to develop and fine-tune their teaching skills. Field-based learning is an essential and valuable component of any teacher education program and preservice teachers should be engaged in field work early and often (Tosun, 2000). Rather than relying on students’ field experiences as the sole vehicle in which to practice, Siwatu & Chesnut (2014) recommend that teacher educators build “teaching” experiences into their coursework. One such training concept that provides preservice teachers with enhanced and extended learning opportunities is course-connected service learning. In a teacher education program, course-connected service learning requires students to apply course objectives to real life contexts and make relevant theoretical concepts, pedagogical techniques, and methodology concrete as opposed to the abstract concepts found in textbooks (Bernakowski, Perry, & Del Greco, 2013).
Rationale

The 2014 *State Preschool Yearbook* from the National Institute for Early Education Research (2015), an annual report profiling state-funded prekindergarten programs in the United States, reported an increase in the number of three and four year olds enrolled in state-funded prekindergarten, prekindergarten special education, and Head Start programs during the 2013-2014 school year. Nationally, 14.5% of three year olds and 41.5% of four year olds were in enrolled in a publicly-funded prekindergarten, prekindergarten special education, or Head Start programs. In Georgia, 10.5% of 3 year olds and 68.4% of four year olds were enrolled in the publicly-funded prekindergarten, prekindergarten special education, or Head Start programs. With increasing enrollments in federal and state funded preschool programs, it is essential teacher education programs create a qualified and knowledgeable preschool teaching workforce. The knowledge base associated with early childhood teaching has changed rapidly in recent years. While teacher education programs have historically focused on child development and the application of child development principles of curriculum and teaching, the current policy expectation is that preschools become more part of the formal schooling. Therefore, policy recommendations concerning the preparation of early childhood teachers propose that the training of students in teacher preparation programs include four general areas: (a) the foundation of early education which includes child development and learning theory and methods courses in pedagogy and curricular approaches, (b) knowledge of the pedagogy involved in teaching young children literacy, math, social studies, science, and the arts, (c) knowledge of the teaching practices and interactions among teachers and children that positively affect children's development and learning, and (d) direct experience with young children in a
variety of settings to use the content they are learning in their coursework (Hyson, 2003; Katz & Goffin, 1990; McCarthy, 1990; Saracho & Spodek, 1983; Spodek & Saracho, 1990).

Although science has not traditionally received the curricular attention afforded language arts/literacy (Brenneman et al., 2009), science content knowledge and practice skills are recognized as critical for K-12 students. For K-12 science, the Next Generation Science Standards (NGSS) provide research-based standards developed by academic researchers, educators, and state-level policymakers to ensure that U.S. students graduate scientifically literate. Although it is a K-12 document, the NGSS acknowledges that children arrive at kindergarten with skill levels, knowledge, and dispositions that support school readiness and achievement in science (NGSS, 2013). Virtually all states have adopted science learning standards. Furthermore, in 2014 the NSTA issued a position statement that recommends teachers and education providers provide science learning experiences for children that engage them with the content and processes of science. Furthermore, the National Association for the Education of Young Children (NAEYC) endorses the NSTA statement affirming that engaging in science practices in preschool can form the basis for a lifetime of science learning in K-12 classrooms and beyond (NAEYC, 2014).

Despite children being ready and eager to engage with the content and practices of science, very little science teaching occurs in preschool classrooms (Brenneman et al., 2009; Greenfield et al., 2009). Teachers spend little time engaged in either planned or spontaneous science-relevant activities (Bowman, 1999; Bowman et al., 2001; Nayfield et al., 2011; Tu, 2006) and often underestimate the competence of young children (Bowman, Donovan, & Burns, 2001). This is disheartening because adults play a critical role in helping children learn science content and skills (French, 2004; Gelman, Brenneman, Macdonald, & Roma´n, 2009; Worth &
Grollman, 2003). Without adult guidance, children’s natural curiosity is overlooked and opportunities to explore, question, spontaneously investigate, and discuss are drastically minimized. One explanation for this phenomenon is that preschool-level teachers have not traditionally been prepared to teach domain-specific knowledge such as science to young children (Isenberg, 2000). Therefore, preschool-level teachers may enter their professional careers without the belief that he or she has the ability to teach science efficaciously.

A number of studies have examined the undergraduate experience in shaping the science teaching self-efficacy of preservice elementary teachers (Bhattacharyya, Volk, & Lumpe, 2009; Brand & Wilkins, 2007; Cantrell, Young, & Moore, 2003; Palmer, 2006; Ramey-Gassert, Shroyer, & Staver, 1996, Tosun, 2000; Wenner, 1993). However, there are no studies that have examined the same of preservice preschool/kindergarten teachers. This study aimed to address this gap in literature. If fostering children’s curiosity in exploring the world around them lays the foundation for a progression of science learning in K-12 and throughout their entire lives, it is important we understand how to “teach the teachers” to be competent and confident guides who will nurture and embrace their natural curiosity and desire to know.

Purpose of the Study

The purpose of this qualitative case study was to describe how preservice birth through kindergarten teachers’ perceived science-teaching efficacy beliefs were influenced as a result of their experience in a science course with connected service learning and how the reported influences align with Bandura’s four sources of self-efficacy. Young children possess curiosity, dispositions, and foundational knowledge that clearly position them to learn the content and practices of science. A possible key to improving preschool science learning is to improve science teaching. To better educate children, we need to better educate those who teach them.
During teacher preparation years, prospective birth through kindergarten teachers need experiences to learn science content, understand how children develop science skills, and practice and apply evidence-based pedagogical techniques.

**Research questions**

To achieve the purpose of this study as described above, the following research questions were addressed: (a) How do preservice birth through kindergarten teachers’ perceive their science-teaching efficacy beliefs are influenced as a result of their experience in a science course with connected service learning, and (b) how do the reported influences align with Bandura’s (1997) four sources of information of self-efficacy?

**Definitions**

**Preservice birth through kindergarten teachers.** Undergraduate students who are preparing to be teachers of children from infancy through kindergarten and teach/work in Pre-K, Kindergarten, Preschool Special Education, Early Head Start, Head Start, and early intervention programs.

**Perceive.** Become aware or conscious of (something); come to realize or understand (Oxford Dictionary, 2015).

**Science-teaching efficacy beliefs.** A teacher’s belief that he or she has the ability to teach science effectively and to affect student achievement (Riggs, 1988).

**Course with connected service learning.** Any service opportunity that was a requirement of the course, mandatory per the instructor, and in which the field experience is built directly into the course requirements and outcomes.
Overview of Self-Efficacy

Most educational researchers credit the concept of teacher efficacy to the theoretical framework of Bandura’s social cognitive theory and his construct of self-efficacy. In his 1977 article “Self Efficacy: Toward a Unifying Theory of Behavioral Change,” Bandura (1977) defined self-efficacy as “beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments” (p. 3). Self-efficacy expectation is a future-oriented, context-specific belief about the level of competence a person expects he or she will display in a given situation. Self-efficacy influences the thinking habits and emotions that enable people to expend the necessary energy to pursue their goals, persist in the face of adversity, rebound from temporary setbacks, and exercise some control over events that affect their lives (Bandura 1986, 1993, 1996, 1997). In terms of teachers, self-efficacy is defined as “their belief in their ability to have a positive influence on student learning” (Ames & Ames, 1985, p.142). Tschannen-Moran, Woolfolk Hoy, and Hoy (1998) noted that teaching self-efficacy “has been defined as both context and subject-matter specific” (p. 215). While a teacher may feel very competent in one subject area or when working with one type of student, they can feel less able in other subjects or with different students.

A second dimension of Bandura’s social cognitive theory distinct from efficacy expectation is outcome expectancy belief. Bandura’s (1997) concept of self-efficacy postulates that we are motivated to perform an action if we believe that the action will have a favorable
result (outcome expectation) if we are confident that we can perform that action successfully (self-efficacy) (Bleicher & Lindgren, 2005). Tschannen-Moran, Woolfolk Hoy, and Hoy (1998) illustrate the distinction between the two dimensions as if the efficacy question is “Do I have the ability to organize and execute the actions necessary to accomplish a specific task at a desired level?,” the outcome question is, “If I accomplish the task at that level, what are the likely consequences?” (p. 210). Such as, if a person has low self-efficacy for swimming, he may expect the outcome of drowning if he falls overboard. Bandura asserts that because outcome expectancies stem from the estimated level of competence a person expects to bring to a given situation, outcome expectancies add little to the predictive power of efficacy measures. However, outcome expectancies in the forms of physical or social awards, recognitions, punishments, or criticisms, can provide incentives and dis-incentives for a given behavior (Bandura, 1986, 1997).

According to Bandura, behavior is based on both factors. Behavior is enacted when people not only expect certain behaviors to produce desirable outcomes (outcome expectancy), but also when they believe in their own ability to perform the behaviors (personal efficacy belief). In Bandura’s 1977 article, Bandura suggests that high self-efficacy beliefs will influence “how much effort people will expend and how long they will persist in the face of obstacles and aversive experiences” (p.194). Bandura (1982) hypothesizes that people with high outcome efficacy and personal efficacy will act in an assured, decided manner and persist on task. Low outcome expectancy paired with high personal efficacy may cause individuals to temporarily intensify their efforts, but will eventually lead to frustration. Persons low on both attributes will give up more readily if the desired outcomes are not reached immediately.

Consequently, teacher efficacy researchers have described high self-efficacy beliefs as ideal. Woolfolk-Hoy, Hoy, and Davis (2009) reported that in comparison to low efficacy
teachers, high efficacy teachers plan more carefully for lessons, effectively consider the organizational framework of the classroom, and demonstrate more successful classroom management skills. Soodak and Powell (1998) found high efficacy teachers are more willing to experiment with new instructional methods and persist even if they find the new techniques difficult provided they can see benefits for learners. Similarly, Ross and Bruce (2007) found teachers who scored higher on self-efficacy measures were more likely to try new teaching ideas, particularly when techniques were difficult. High-efficacy teachers have also been found to attend more closely to the needs of lower ability students and less likely to refer them to special education (Ross & Bruce, 2007; Soodak & Podell, 1998). However, Wheatley (2002) found this assumption problematic and presented a different perspective. He contends that high self-efficacy beliefs are not always beneficial and that self-efficacy doubts are not always problematic. According to Wheatley, self-efficacy doubts can motivate teachers to learn and improve their teaching skills in an attempt to remain (or become) an effective teacher. Wheatley also suggested that teachers who have a false sense of their capabilities might actually be prone to professional burnout –

“… teachers sometimes develop a sense of certainty that sets them up for disillusionment and burnout. The teacher may blame the students or whomever for their struggles, when the real problem was overconfidence, that is, too positive efficacy. This perspective contrasts with the usual assumption that it is teachers’ efficacy doubts that are a key culprit in teacher burnout and attrition” (p. 12).

Self-efficacy is distinct from self-concept, self-worth, and self-esteem because it is specific to a specific task. For instance, Gist & Mitchell’s (1992) differentiate between self-esteem and self-efficacy as: “Self-esteem usually is considered to be a trait reflecting an
individual’s characteristic affective evaluation of self (e.g., feelings of self-worth or self-liking),” whereas, self-efficacy is a judgment about task capability that is not inherently evaluative” (p. 185). In other words, a person who feels hopelessly inefficient for a particular activity, such as knitting or ice skating, may not suffer diminished self-esteem, because that person has not invested self-worth in doing that activity well. On the other hand, high achievers may display a great deal of skill and yet evaluate themselves negatively because they have set personal standards that are too high to meet. Individuals may question their self-worth despite being very competent, if others important to them do not value their accomplishments (Bandura, 1977).

An important distinction of self-efficacy is that it has to do with self-perceptions of competence rather than actual level of competence. People regularly tend to overestimate or underestimate their actual abilities. Thus, these estimations may have consequences for the course of action they choose to pursue or the effort they exert in those pursuits. Over- and underestimating capabilities may also influence how well people use the skills they possess. As stated by Bandura (1997), “A capability is only as good as its execution. The self-assurance with which people approach and manage difficult tasks determines whether they make good or poor use of their capabilities. Insidious self-doubts can easily overrule the best of skills” (p. 35). He further asserts that slightly overestimating one’s actual capabilities has the most positive effect on performance (Bandura, 1977).

Bandura (1986, 1997) proposed four sources of efficacy expectations: mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states. The four sources of efficacy information will be described as they relate to teacher efficacy.

Mastery experiences. Mastery experiences (also referred to as enactive experiences) are the most powerful source of efficacy information. The perception that a
performance has been successful raises efficacy beliefs, which contributes to the expectation of proficient performance in the future. Efficacy beliefs are strengthened greatly when success is achieved on difficult tasks with little assistance or when success is achieved early in learning with few setbacks; however, not all successful experiences encourage efficacy. For example, efficacy is not enhanced when success is achieved through considerable external assistance or on an easy, unimportant task. The perception that one’s performance has been a failure lowers efficacy beliefs, which contributes to expectations that future performances will be inept. This attack on efficacy is likely when the failure occurs early in learning and cannot be attributed to a lack of effort or events outside of the person’s control (Bandura, 1986, 1997).

Although self-perception is influenced by all four sources, mastery experiences and physiological arousal associated with the experiences directly influence self-perception. It is only in a situation of actual teaching that an individual can assess the capabilities he or she brings to the task and experiences the consequences. It is in the actual situations of teaching that teachers gain information about how their strengths and weaknesses are displayed in managing, instructing, and evaluating a group of students. For example, enthusiasm is an asset when working with a group of students but it is not enough to compensate for a lack of planning.

*Vicarious experiences.* Watching others teach in skillful and adept ways from the vantage point of being a student - especially observing admired, credible, and similar models - can affect an observer’s personal teaching competence. Comparison to others can lead to beliefs that they also have the capabilities to be successful teachers under similar circumstances (Bandura, 1977, 1986). Similarly, watching others teach and fail despite strong efforts will erode efficacy beliefs and lead to the conclusion that the task is unmanageable, unless the observer believes that he or she is more capable than the model.
Social persuasion. Social persuasion (also referred to as verbal persuasion) can be general or specific. Coursework and professional development workshops give teachers information about the task of teaching and provide strategies and methods teachers can add to their arsenal of teaching skills. However, these new skills may not have an impact on self-perceptions of teaching competence until they are used successfully to enhance student learning. The potency of the persuasion depends on the credibility, trustworthiness, and expertise of the persuader (Bandura, 1986). Social persuasion can contribute to successful performances to the extent that a persuasive boost leads a person to attempt new strategies or to try hard enough to succeed (Bandura, 1982). However, when individuals do not have the skills to perform well on a particular task, advisements to work harder are likely to exacerbate low self-efficacy (Gist & Mitchell, 1992).

Specific performance feedback from instructors, supervisors, other teachers, and even students can be a potent source of information about how a teacher's skills and strategies match the demands of a particular teaching task. Specific performance feedback provides social comparison information or information about whether the teaching performance and outcomes were adequate, inferior to those of others teaching in similar situations or superior to those of others teaching in similar situations. Social persuasion may lower self-perceptions of personal teaching competence if the feedback is overly harsh and general rather than focused and constructive. In response to critical feedback, teachers may adopt the self-protective strategy of concluding that under the particular set of circumstances achieving the hoped-for results were impossible.

Physiological or emotional states. The level of physiological and emotional arousal a person experiences in a teaching situation adds to his or her self-perceptions of teaching
competence. Feelings of relaxation and positive emotions signal self-assurance and the
anticipation of future success (Bandura, 1996). Arousal, such as increased heart and respiratory
rates, butterflies, increased perspiration, or trembling hands, can be read either positively as
excitement or negatively as stress and anxiety. All of these depend on the circumstances, the
person's history, and the overall level of arousal (Bandura, 1997). The degree of arousal must
also be considered. Moderate levels of arousal can improve performance by focusing attention
and energy on the task. However, high levels of arousal can impair functioning and interfere with
making the best use of one's skills and capabilities. In order for physiological states to have an
effect, they must be acknowledged. If the task itself requires the full attention of a person, then
emotional states may have little influence on the sense of personal teaching competence.

Research studies have reported that teacher preparation and professional development
efforts that only focus on developing high quality teaching skills may not predict whether the
teachers will utilize the newly acquired skills in their classrooms (Chong & Kong, 2012; Siwatu,
concerned not with the number of skills you have, but with what you believe you can do with
what you have under a variety of circumstances” (p. 37). Hence, preparation efforts and
professional development activities designed to nurture resilient self-efficacy beliefs of teachers
should incorporate Bandura’s four factors known to influence self-efficacy formation (Siwatu,
2009, 2011; Ross & Bruce, 2007).

Self-Efficacy Beliefs of Preservice Teachers

As a result of learning and educational experiences from kindergarten through college,
strong beliefs about teaching and learning are deeply imbedded and formed in the minds of most
preservice teachers. According to Kagan (1992), these beliefs are tenacious and difficult to
change. However, changing beliefs about teaching and learning among preservice teachers is crucial if teacher educators hope to change instructional practices, as these beliefs are at the heart of most aspiring teachers’ ideas about what constitutes good teaching.

As Wideen, Mayer-Smith, & Moon (1998) determined in their review of preservice teacher learning, beliefs serve as strong filters as how preservice teachers experience and respond to teacher education programs. Therefore, exposing deeply held beliefs is a difficult but necessary process to enable preservice teachers to critically examine and understand the content of their future profession. If emphasis is placed on teachers’ skills only, and teachers’ beliefs are not taken into account, any change in instruction is hindered (Alger, 2009). Changing, or at very least challenging, beliefs is also important because static, implicit beliefs may limit (act as filters) the range of ideas or actions that preservice teachers are willing to consider (Alger, 2009; Fives & Buehl, 2012).

The development of teacher efficacy beliefs among prospective teachers has generated a great deal of research interest because efficacy beliefs are somewhat resistant to change once they are established. There is some evidence that coursework and practica impact personal and general teaching efficacy differently. It seems that general teaching efficacy beliefs (beliefs about the task), are more likely to change when students are exposed to vicarious learning experiences or social persuasion, such as college coursework (Watters & Ginns, 1995), while actual teaching experiences during student teaching practica have a greater impact on personal teaching efficacy (Housego, 1992; Hoy & Woolfolk, 1990). General teaching efficacy has also shown a decline during student teaching (Hoy & Woolfolk, 1990; Spector, 1990), suggesting that the optimism of young teachers may be somewhat tarnished when they are confronted with the realities and complexities of the teaching task.
The difference between a vicarious learning experience and a mastery experience has been compared to “… the difference between enjoying a well told joke and attempting to retell it. One may enjoy the skill and ease with which the joke was told but then feel self-conscious and fumble when trying to retell it” (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998, p. 235). Although a preservice teacher may marvel at the skill with which an experienced teacher presents a well taught lesson, they may fail in trying to present a similar lesson. Thus, while extensive social persuasion and vicarious experiences included address the beliefs about task requirements of teaching, they do little to raise self-perceptions of teaching competence.

Student teaching is the culminating course in a university or college undergraduate education program leading to teacher education and certification. Student teaching provides an opportunity to gather information about one's personal capabilities for teaching. However, when it is experienced as a sudden, total immersion “sink-or-swim” experience, it is likely detrimental to building a sense of teaching competence (Tschannen et al., 1998). Student teachers often underestimate the complexity of the teaching task and their ability to manage many agendas simultaneously, interact as peers with their students, or find their classes out of control growing overly harsh and ending up not liking their "teacher self." They become disappointed with the gap between the standards they have set for themselves and their own performance. Student teachers sometimes engage in self-protective strategies, lowering their standards in order to reduce the gap between the requirements of excellent teaching and their self-perceptions of teaching competence (Weinstein, 1998).

Teacher preparation programs need to give preservice teachers frequent opportunities for actual experiences with instructing and managing children in a variety of contexts with increasing levels of complexity and challenge to provide mastery experiences and specific
feedback. According to Cook and Young (2004), if teacher educators are to combat the firmly rooted beliefs that preservice teachers bring with them into teacher education programs, they must understand the most powerful ways to do this. Namely, interactions with children have the power to disrupt and change teacher beliefs. Such interactions offer personal mastery experiences that teachers may perceive as more credible and valid than secondary reporting of classroom activities. Through analysis of weekly reflections about beliefs, Cook and Young (2004) found that 18 preservice teachers they followed reported that their beliefs were challenged and changed regarding what teachers do, how they should be, and what they should know as a result of their interactions with students. This finding is in keeping with Jones and Visilind’s (1995) finding that “interactions with pupils in schools is the most powerful source of information in constructing beliefs of preservice teachers” (p. 355). During the course of their preparation, preservice teachers should be given opportunities to develop and fine-tune their teaching skills. Rather than rely solely on students’ field experiences as the vehicle in which to practice, Fives and Gill (2015) recommend teacher educators build “teaching” experiences into their coursework.

Self-efficacy Beliefs of Preservice Teachers towards Science Teaching

The self-efficacy construct is especially relevant to science teachers because science is often seen as a difficult subject for students to learn and for teachers to teach (Bursal, 2010; Drew, 2011; Johnstone, 1991). Research on science teaching self-efficacy has focused most on the influence of mastery experiences, perhaps because Bandura argued that such experiences typically had the greatest effect on self-efficacy. The results of these studies have had mixed results. Some have documented that preservice teachers became more confident in early field experiences teaching science (Cannon & Scharmann, 1996; Cantrell, Young, & Moore, 2003),
while other researchers reported no difference in teachers’ science self-efficacy related to early field experiences (Yilmaz & Cavas, 2008).

In general, positive past experiences with science and science instruction appear to have a consistent influence on science teaching self-efficacy. For example, qualitative investigations have revealed that positive authentic science teaching experiences can be a powerful source of self-efficacy among pre-service elementary teachers (Carrier, 2009; Gunning & Mensah, 2011). Preservice teachers who were more self-efficacious were also more like to report having positive experiences in science as K-12 students (Bleicher, 2004; Hechter, 2011). Other positive childhood experiences with science such as conducting science experiments at home have been reported as positively influencing primary teachers’ science self-efficacy (Mansfield & Woods-McConney, 2012).

Mastery of science content also appears to have an influence on teaching self-efficacy. Preservice elementary teachers who had taken more college science classes were more likely to be self-efficacious when it came to teaching science (Bleicher, 2004; Bursal, 2010; Hechter, 2011). Even the number of science classes taken in high school were found to influence their self-efficacy (Cantrell, Young, & Moore, 2003; Mulholland, Dorman, & Odgers, 2004). Teacher education programs designed to improve content knowledge have led to similar results. Preservice elementary teachers who enrolled in methods classes designed to support understandings of earth science demonstrated improved conceptual understanding and had higher science self-efficacy (Bleicher, 2007; Bleicher & Lindgren, 2005). Liang and Richardson (2009) found prospective elementary teachers who engaged in their own inquiry-based research projects had greater science self-efficacy gains than did peers not engaged in such projects.
The mastery of pedagogical skills is also important in the development of science teaching self-efficacy. A longitudinal study of preservice primary teachers enrolled in a science methods course which included the students planning, teaching, and evaluating a hands-on science lesson to a primary school child in a one-to-one situation, reported that learning how to teach their subject matter was a powerful source of science self-efficacy (Palmer, 2006a). When preservice teachers were interviewed nine months and a year after the end of the course, they reported that participation in a subsequent teaching practicum had reinforced their science self-efficacy. Similarly, Settlage (2000) found that instruction about the learning cycle (a pedagogical technique) contributed to preservice elementary teachers’ self-efficacy.

Early field experiences that provided preservice teachers with opportunities to apply content knowledge and teaching strategies in authentic settings have been found to improve preservice teachers’ science teaching self-efficacy (Mulholland, Dorman, Odgers, 2004; Swars & Dooley, 2010). Brand and Wilkins (2007) found that, upon completion of a science methods class, preservice elementary teachers were most likely to identify mastery experiences in the form of content or pedagogical knowledge as sources of improved self-efficacy.

Preservice teachers have identified many forms of vicarious experiences as improving their science self-efficacy. Preservice teachers reported higher self-efficacy following a science methods class where they saw videos of master teachers, observed science teachers in their field experiences, and took classes in which the instructor modeled effective practices (Bautista, 2011). In follow-up interviews, participants identified these vicarious experiences as more powerful sources of their self-efficacy than the feedback they received or the experiences they had planning and implementing lessons in their field placements. In a study by Palmer (2011), preservice teachers identified vicarious experiences in the form of observing peers or college
instructors as important sources of efficacy, particularly in the absence of authentic teaching experiences. In a case study by Mulholland and Wallace (2001), an elementary teacher recalled few experiences in which she had seen her cooperating teachers teach science at her preservice field placements. Once she was employed, she found that other teachers shared their own doubts and misunderstandings about their science instruction. Teachers who arrive at schools without adequate support in scientific content and teaching strategies may become less confident when surrounded by experienced teachers who are themselves less confident and less competent as science teachers.

Few researchers have explored social persuasion or physiological and emotional states in the context of science teaching. Cone (2009) explored the self-efficacy of preservice teachers in a science methods course designed to provide them with mastery experiences, vicarious experiences and social persuasion. The feedback teachers received following a simulated lesson was a powerful source for most teachers and rated as the most influential source of their self-efficacy. In Mulholland and Wallace’s (2001) case study, social persuasions – in this case, the excitement and engagement of students during science lessons – provided a powerful source of self-efficacy for an elementary teacher as she transitioned from being a preservice to an inservice teacher. Bursal (2012) found preservice teachers who completed a science methods course with authentic teaching experiences were more self-efficacious, but were not significantly less anxious about teaching science in general.

Clinical Experiences of Preservice Teachers

For teacher education programs preparing preservice teachers for the field of teaching entails a series of clinical experiences preceding student teaching. These experiences are staggered so that there is a gradual increase in the length of the experience, amount of
responsibility, and degree of complexity inherent in each clinical experience. When provided early on and frequently throughout the program, clinical experiences allow learners to develop conceptual frameworks that assist them in organizing, conceptualizing, and better understanding the theories and ideas presented in their academic work (Bernakowski, Perry, & Del Greco, 2013; Flores, 2015). Three approaches which include in-depth experiences working in real-world settings and allowing preservice teachers opportunities to make informed self-efficacy appraisals are: (a) field experiences, (b) course connected service learning, and (c) professional development schools (Bernakowski et al., 2013; Wingfield, Nath, Freeman, & Cohen, 2000; Woolfolk-Hoy, 2000).

Field experiences. Field experiences are within-course requirements which correlate to and supplement the content being taught in a course (Ben-Peretz, 1995). In-field experiences may include observations in classroom settings, tutoring students, reading to students, interviewing teachers, or working with special needs children in a supervised setting (Flores, 2015). Field experiences conclude with a final internship, also known as student teaching, which is completed during the student’s final semester of their program of study. Field experiences typically begin the first semester of teacher education programs and are under the guidance and support of a cooperating teacher. The cooperating teacher plays the critical roles of model and mentor and has great influence over the student teacher’s learning experience.

Course connected service learning. Service learning, also known as community-based learning, is becoming an increasingly utilized teaching and learning strategy across the country. The National Society for Experiential Education (1994) defines service learning as “any carefully monitored service experience in which a student has intentional learning goals and reflects actively on what he or she is learning through the experience.” Teacher education
programs have begun to incorporate service learning as a student-centered pedagogy that connects authentic, meaningful service with academic study and reflection (Eyler & Giles, 1999).

Teacher education programs often use service-learning experiences to extend field experiences already present in the program. Distinctions made with service learning experiences include preservice teachers becoming more reflective practitioners, problem solvers, and collaborative partners within a community.

Participation in service learning during teacher education courses, particularly those experiences of high quality and supported by course instructors, have been shown to be a worthwhile and powerful experience for preservice teachers. Academic outcomes of service learning claimed by researchers include enhanced critical thinking (Eyler & Giles, 2002, knowledge acquisition (Astin & Sax, 1998; Hart & King, 2007), understanding of content (Eyler & Giles, 2002; Kirtman, 2008; Tannenbaum & Barrett, 2005), knowledge application (Michael, 2005; Wasserman, 2009), theory-to-practice connections (Brown, 2005; Dodd & Lilly, 2000; Wade, 1995), and pedagogical knowledge (Cox-Petersen, Spencer, & Crawford, 2005).

Personal outcomes claimed in the literature include increases in self-confidence (Astin & Sax, 1998; Astin, Vogelgesang, Ikeda, & Yee, 2000), self-awareness and sense of worth (Dodd & Lilly, 2000; Furco, 2002; Malone, Jones, & Stallings, 2002), self-efficacy (Root, Callahan & Sepanski, 2002), sense of making a difference in the world (Carlan & Rubin, 2005; Wade, 2003), and awareness of others and the world (Carlan & Rubin, 2005; Miller & Gonzales, 2010).

Social outcomes described by researchers include increases in commitment to helping others (Astin & Sax, 1998; Fenzel & Leary, 1997), cultural sensitivity (Boyle-Baise, 2005),
value of student collaboration (Lambright & Lu, 2009), and contributions to and responsibility for community (Cox-Petersen, Spencer, & Crawford, 2005).

Professional development schools. The National Council for Accreditation of Teacher Education (NCATE) defines professional development schools (PDSs) as “innovative institutions formed through partnerships between professional education programs and P–12 schools” (2010, http://www.ncate.org/ProfessionalDevelopmentSchools). The mission of a PDS partnership is: (a) the preparation of new teachers, (b) faculty development, (c) inquiry-directed at the improvement of practice, and (d) enhanced student achievement. PDSs are extremely important in enhancing teacher quality and student achievement in urban schools with high needs populations.

PDSs are often compared to teaching hospitals. Teaching hospitals were designed to provide clinical preparation for medical students and interns; PDSs serve the same function for teacher candidates and in-service faculty. Both settings provide support for professional learning in a real-world setting in which practice takes place. Several preservice teachers often work at the same site, and each may work with several cooperating teachers. The preservice teachers have time to observe, analyze, and provide feedback to one another. At the professional development school, cooperating teachers engage in coursework and other professional development activities, exploring teaching practices so they can be competent and thoughtful mentors and supervisors. In most professional development school models, a liaison between the professional development school and the university coordinates the program and acts as a resource.
Conclusion

Self-efficacy can be simply defined as an individual’s belief in his or her own competence. Grounded in Bandura’s social cognitive theory (1986), a strong sense of self-efficacy enhances an individual’s sense of accomplishment and determines whether or not an individual will perceive a task within or beyond their reach. According to Bandura (1997), self-efficacy beliefs are influenced by the interpretation of four sources: mastery experience, vicarious experience, social persuasion, and physiological and emotional arousal.

Self-efficacy, as it relates to education, is a teacher’s belief or judgment about his or her own abilities to teach effectively. Teachers’ self-efficacy is defined as both context and subject-matter specific (Tschannen-Moran et al., 1998). In an effort to improve science teaching in elementary schools, several researchers have examined the science teaching self-efficacy beliefs of preservice primary and elementary education teachers (Brand & Wilkins, 2007; Cantrell, et al., 2003; Wingfield et al., 2000; Settlage, 2000). Examination of science method courses and field experiences in terms of Bandura’s (1997) four sources of self-efficacy have found the presence of these sources have enhanced the science teaching self-efficacy of prospective primary and elementary education teachers (Bautista, 2011; Brand & Wilkins, 2007; Bursal, 2012; Cone, 2009; Palmer, 2011). While these studies provide insight into the sources influencing the science teaching self-efficacy of preservice primary and elementary education teachers, examining how science-related coursework and authentic teaching experiences influence preservice birth through kindergarten teachers’ self-efficacy towards teaching science remains to be learned. Based on the significance of teaching efficacy, the aim of this study is to address this gap in literature.
CHAPTER 3
RESEARCH DESIGN AND METHODS

Overview

The purpose of this study was to describe how experiences in an innovative science course with connected service learning influenced preservice birth through kindergarten teachers’ efficacy towards teaching science and how the reported influences aligned with Bandura’s four major sources of self-efficacy. The research questions that guided this study, grounded in Bandura’s social cognitive theory specifically his concept of self-efficacy, were: (a) How do preservice birth through kindergarten teachers perceive their experiences in a science course with connected service learning influence their self-efficacy towards science teaching, and (b) How do these reported influences align with Bandura’s (1997) four sources of information of self-efficacy?

This qualitative descriptive case study used an interpretive research approach. Qualitative case study is an appropriate methodology when a holistic, in-depth investigation is needed (Feagin, Orum, & Sjoberg, 1991). Interpretive research in education describes “… school [as] a lived experience” (Merriam, 1998, p.4) and understanding the meaning of the experience constitutes the knowledge gained from an inductive mode of inquiry. Yin (1984) provides three reasons for selecting the case study method: (a) case studies are the preferred strategy when how or why questions are being posed, b) when the investigator has little control over events, and (c) when the focus is on a contemporary phenomenon within some real-life context. Thus, case study was deemed an appropriate approach for this study seeking to describe how a small
number of preservice teachers perceived their self-efficacy towards teaching science was
effected by their experiences in a particular course.

*Qualitative Case Study Design*

Qualitative research is considered ideally suited to the “messy” construct of teachers’
beliefs (Pajares, 1992), as the development of a complex, detailed understanding of teachers’
beliefs can be established by talking directly with teachers, going to their schools, and allowing
them to tell their stories (Creswell, 2013). In the field of teachers’ beliefs, qualitative research
has contributed to the development of knowledge by leading to “improved understandings of the
complex and interrelated process of personal experiences, beliefs, and practices” (Fang, 1996, p.
60). One of the strengths of qualitative research applied to the study of teachers beliefs is it can
lead to a more in-depth understanding of a phenomenon. From the collected data, qualitative
inquiries produce rich descriptions of the context, the participants, and the topic of study
(Merriam, 2009). Another advantage of qualitative methodologies is that data collection typically
occurs in natural settings (Creswell, 2013). Observing teachers in the classroom and seeing them
behave and act in the context of their teaching allows researchers to move beyond reliance on
self-reported forms of data (Fives & Gill, 2015). Using classroom observation provides
researchers with the opportunity to capture data related to instructional practices, an important
consideration when studying the relationship between teachers’ stated beliefs and their practices.

Carr and Kemmis (1986), educational researchers, classify three basic forms of
educational research – positivist, interpretive, and critical. In positivist forms, education is
considered an object of scientific, objective, and quantitative study. In interpretive forms,
education is considered a process or lived experience understood through inductive or theory-
generating inquiry. In critical research, education is considered a social institution understood
through ideological critiques of power, privilege, and oppression. I choose the interpretive or qualitative perspective because I did not want to test a theory, set up an experiment, or measure anything. I was interested in understanding the experiences of five preservice teachers enrolled in a particular course and how this experience influenced their self-efficacy towards teaching science. Interviews and observations were my primary means of producing the knowledge to answer my research questions.

Merriam (1998) describes a qualitative case study as an “intensive, holistic description and analysis of a single instance, phenomenon, or social unit” (p. 27). Miles and Huberman (1994) described a case study as being like a circle with a heart in the middle. The heart is the focus of the study, while the circle binds or “defines the edge of the case: what will not be studied” (p.25). In other words, to qualify for a case study, a researcher must delimit or “fence in” (Merriam, 1998, p. 27) what they are going to study. For instance, you have to limit the number of people you intend to interview and predetermine the length of time you intend to spend on the study. If there is no end, actually or theoretically, to the number of people who could be interviewed or observed, then the phenomenon is not bounded enough to qualify as a case (Merriam, 1998, p.28). In the matter of this study, the case or smallest “unit of analysis” (Miles and Huberman, 1994) were the participants’ perceptions of how their experience in a science-related course with connected service learning influenced their science teaching self-efficacy. The factors that bound the case in this study were the course with connected service learning itself, the length of the course, and the number of preservice birth through kindergarten teachers enrolled in the course.

Merriam (1998) asserts case studies can be further defined by their disciplinary orientation and by their intent (Merriam, 1998). The discipline orientation, or field of study, in
this case study is education. The overall intent of the case study can further define it – is the intention of the researcher to describe, build theory, or present judgment. Three main types of case studies described by Merriam (1998) are: (a) descriptive, (b) interpretive, and (c) evaluative. A descriptive case study provides a detail account of a phenomenon in education where little research has been conducted, is atheoretical, and often forms a database for future comparisons and theory building. An interpretive case study develops conceptual categories or to illustrate, support, or challenge theoretical assumptions held prior to data gathering. An evaluative case study involves describing, explaining, and producing judgment. This case study was descriptive because of its’ intent - to gain insight into how participating in an innovative science course with connected service learning might influence the science teaching self-efficacy of future birth through kindergarten teachers.

Context of the Study

Qualitative case studies are conducted within real-life contexts; therefore, according to Marshall & Rossman (2003), “context matters” (p. 53). By the nature of their design, case studies are suited to situations in which it is impossible to separate the phenomenon from its context and strong consideration must be given to the context that the phenomenon is bounded by. It is the phenomenon’s specific settings that guide sampling procedures and play a central role in the data collection and analysis. For this study, the phenomenon in question was how participation in a science course with connected service learning influenced preservice teachers’ self-efficacy towards teaching science to preschoolers. Detailed descriptions of the contexts follow.

The Birth through Kindergarten Teacher Preparation Program. The Birth through Kindergarten Teacher Preparation Program is offered at a large southeastern university. It is an
undergraduate program which prepares beginning professionals for public school teaching positions in Pre-K, Kindergarten, and Preschool Special Education, along with positions with Early Head Start, Head Start, and early intervention programs. The students enter the cohort program in the fall of their junior year and progress through required coursework together. Each semester features a nine hour practicum experience at various levels which include infant/toddler, preschool, prekindergarten, and kindergarten, culminating in a semester spent student-teaching in a local prekindergarten or kindergarten class. As part of their experience, they are able to take advantage of the program’s partnership with the local school district’s early learning center.

*Early Learning Center (ELC).* The Early Learning Center manages the operation of the school district’s early childhood education programs. These include the state lottery funded Pre-Kindergarten Program, federal Early Head Start and Head Start, and Preschool Special Education. Through collaboration among these programs, the County School District’s Office of Early Learning serves over 1200 students. Approximately 150 of these children are served at the ELC.

The ELC is part of the Professional Development School (PDS) partnership between the University and the County School District. The mission of the professional education program and P–12 schools partnership is to: (a) connect educational research and theory with practice, (b) share our collective expertise to develop innovative solutions to problems, (c) facilitate the professional development of faculty in both institutions, (d) provide opportunities for high quality clinical experiences for educator preparation, (e) engage in shared inquiry focused on teaching and learning, and (f) improve the quality of education for all our students through the use of active, student-centered teaching strategies.
Service learning. The university uses service-learning to help integrate two core aspects of its mission—teaching and service. Using Bringle & Hatcher’s (1995) definition of academic service-learning, the university defines service learning as:

“a course-based, credit-bearing educational experience in which students participate in an organized service activity that meets identified community needs, and reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of personal values and civic responsibility.”

Service-learning is distinct from practica, field experiences, and community service because the service activity is connected to the course learning goals through reflection and critical analysis, and seeks to balance the benefits to the student with benefits to the community partners. The community partner for this service learning was the County ELC.

Coursework. The Birth through Kindergarten students’ coursework includes: infant/toddler development and teaching methods, preschool curriculum development, service-learning course teaching science through nature, observation and assessment techniques, communication and language development, and teaching methods for children with developmental delays.

During the second semester of their program of study, preservice birth through kindergarten teachers are required to take a three hour credit science-related course with connected “nature as teacher” service learning. The course is designed to instruct preservice birth through kindergarten teachers on how to embed early learning standards and instruction through nature and gardening and to “plant the seeds” of environmental awareness. The course objectives are: (a) engagement in interdisciplinary collaboration and educational theory and practice in science, language arts, early childhood education, horticulture, ecology, service, and
reflection, (b) awareness of the effects of ‘nature connection’ on child development through activities in science, language arts, and puppetry in indoor and outdoor settings, (c) engagement as a community partner, (d) development of activities which contribute to improving children’s relationships with nature, healthy eating, and social relationships, and (e) development of a sense of community involvement and civic engagement that will continue into their professional careers. The course is divided into two components: instructor-led course sessions and service learning sessions (referred to as Nature Explorer Club (NEC). The two hour service learning sessions with the preschool classes were scheduled Tuesday through Friday mornings and the two hour course sessions were held Friday afternoons. Hence, all preservice teachers had taught the planned lessons with their assigned preschool classes prior to the course sessions.

Course sessions. The course supported a constructivist framework in that students gained knowledge through active processes that built upon their prior experiences and understandings. During class, the preservice teachers were involved in reading, discussing, and reflecting on ideas and strategies introduced in the course. The course sessions were divided into three primary areas: discussion, lesson planning, and reflection. Instructors assessed preservice teachers’ learning through the course discussions and activities. Each course session was guided by an agenda which allocated sufficient time for: (a) discussions, (b) reflections on the lesson taught during the week’s NEC, (c) review and discussion of upcoming week’s lesson plan, and (d) preparation of teaching and gardening materials. Instructors-led discussions focused on assigned readings and/or course-related topics such as science content, processes, and dispositions, puppetry as a teaching tool, teaching through nature, journaling with young children, embedding other readiness areas within science lessons. Instructor-led reflective discussions encouraged preservice teachers to think and talk about the service learning sessions
they had conducted during the week. Reflective topics included if learning goals were achieved, what went well in the lessons and why, what problems were experienced and why, what could have been done differently, and how the lesson could be improved for future teaching or improved what was learned from the experience that will help in the future. Lesson plans for the upcoming week were presented and modeled by whoever developed them, either the instructors or preservice teachers. As a group, the instructors and preservice teachers would review each component of the lesson plan and modify as needed. The following subsection describes lesson plan requirements in more detail. The preparation of teaching materials and garden maintenance were done at the end of class.

The students were required to contribute to discussions, encouraged to ask questions, and share their insights and reflections of their own personal course experiences. Class participation accounted for 20% of the final grade.

*Lesson Plans.* Lesson plans for the nature club included the following theme-related elements: puppet show script, two activities, and closing song. Lesson plan topics included: nature is all around, seeds and vegetable gardens, soil and worms, parts of a plant, what a plant needs to grow, tools of a scientist, senses and science, life cycle of a butterfly, and parts of insects. The first four nature club sessions’ lesson plans were developed by the instructors. During the course session, the instructors modeled effective ways of implementing the lessons with preschool-aged children. For the remainder of the lesson plans, preservice teachers were expected to begin connecting the knowledge gained from their observations of the instructors and their understanding of effective science teaching practices to teaching itself. Lesson plans for the 5th through 8th sessions were primarily developed by the instructors (puppet show and one activity) and the preservice teachers worked with their partners to develop a second topic-related
small group activity. Lesson plans for the 9th through 12th sessions were entirely developed by the preservice teacher teams. Preservice teachers were given an instructor-developed template used for lesson plan development and included learning objectives, targeted concepts and vocabulary, materials needed, transition into activity, opening, mini-lesson, work session, closing, transition out of activity, adaptations/modifications, assessment, rainy-day alternatives, and classroom or garden follow-up. The preservice teachers modeled the puppet shows and described in detail the small group activities during course sessions. Lesson plans accounted for 30% of the final grade.

*Course Connected Service Learning.* The instructors partnered preservice teachers and assigned each pair two preschool classes and a morning they were to lead NEC. There were nine students in the cohort so one student volunteered to conduct her nature club sessions with two year olds. Another student withdrew from the course and the other students or instructors volunteered to co-teach the nature club with the partner-less student. Each preschool class participating in the NEC had a designated gardening bed located on the playground area or surrounding outdoor space. The garden plots were labeled with the classroom teachers’ names. The preservice teachers began the NEC sessions the third week of the course. Each service learning session lasted approximately two hours (time to set up, conduct two 30 minute NEC sessions, and clean up). NEC implementation and participation accounted for 50% of the final grade.

To afford all three to five year olds enrolled at the center an opportunity to participate in a NEC, larger classes were combined with smaller groups or ‘self-contained’ special education classes. Groups ranged approximately from 18 – 30 students. The Head Start and PreK classes were typically accompanied by a lead teacher and up to two teacher assistants. The preschool
special education classes were accompanied by a special education teacher and up to two paraprofessionals depending on the class size and students’ needs. At times, speech language pathologists, related service staff (occupational therapist), or special education student teachers in practicums accompanied the classes. In general, approximately five adults, not including the preservice teachers who led the NEC, accompanied the combined groups of children.

The NEC sessions included: (a) a puppet show, (b) two small group activities, and (c) a closing activity. Each NEC session began with a puppet show to introduce the lesson. One preservice teacher would read the script while their partner performed the puppet show. Following the puppet show, the children were divided into two groups and transitioned into small group activities. The children wore colored tags to easily sort them into groups. Typically, the preservice teachers would lead one small group activity and the classroom teachers and assistants lead the second activity. Classroom teachers were emailed the lesson plans the week prior to review and familiarize themselves with the content. After approximately 10 minutes, the groups switched activities. Following the completion of the second activity, the children transitioned back to the carpet where the preservice teachers reviewed the lesson and sang the NEC closing song.

The puppet theater was housed in the professional learning classroom so all NEC sessions began there. To accommodate the sessions, tables and chairs were moved off to the side of the room leaving an open space. White duct tape was used to define an approximately 8’ X 10’ area in front of the puppet theater which served as a boundary for the children to sit in during large group activities. When the weather permitted, the preservice teachers would transport the teaching materials and supplies outside to conduct the small group activities. Unfortunately, due to unusually cold and wet weather, most of the sessions were held indoors in the professional
development classroom (two of the six scheduled nature club sessions observed were observed indoors due to the weather). To do the small group activities, the preservice teachers would designate areas for each activity, set up the materials, and conduct the activities in the most naturalistic manner as possible as if the children were outside. For instance the lesson plan, “Tools of a Scientist,” was modified to indoors to simulate planting. Large flower boxes were filled with potting soil and the children use the tools to plant the seedlings. In between the two sessions, the preservice teachers would gently remove the seedlings from the flower boxes, return them to the containers, and simulate the lesson the same way with the second group.

Following the first NEC, the instructors arranged for the preservice teachers to meet with their assigned classroom teachers. The intention of this meeting was to reflect on the nature club and discuss their students and future lesson plans.

Instructors. The course is co-taught by: (a) the clinical instructor in the College of Education Birth through Kindergarten Teacher Preparation Program who is also the Professor-In-Residence at the Early Learning Center Professional Development School District and (b) the education director from a local botanical garden and adjunct faculty member with the College of Education of Mathematics and Science Education Department. The education director from the botanical garden is also a Service Learning Fellow at the university and previously taught a course in which university students ran an after-school gardening program with elementary school students. In 2012, the instructors collaborated and designed and implemented the science course with connected service learning. The course was primarily designed to instruct university birth through kindergarten program students on how to use puppetry, nature, and gardening as instructional tools while planting the seeds of environmental awareness. The service learning
course was coordinated with the director of the early learning center and the prekindergarten director.

Sampling and Participant Selection

The type of sampling used for this study was purposeful sampling. Purposeful sampling, also known as judgmental, selective or subjective sampling, is a non-probability sampling technique. Patton (2002) describes purposeful sampling as a method that focuses on the selection of information-rich cases whose study will illuminate the questions under study and from which one can learn a great deal about issues of central importance in answering the research questions. For this case study, I used purposeful sampling to select the program, the course, and consequently the preservice teachers themselves.

To begin purposeful sampling, selection criteria was first selected. Following LeCompte and Preissle’s (1993) recommendations, I created a list of the attributes essential to my study and then proceeded to find a unit matching the list. The criteria I established directly reflected the purpose of my study and guided me in the identification of information-rich cases. The two criteria for participant selection were: (a) the participants must be enrolled in the Birth through Kindergarten teacher preparation program and (b) be enrolled and intended on completing the science course with connected service learning. The recruitment process by which participants were informed of and invited to participate in this study occurred at the end of the fifth class of the course. It is important to note that the course began January 9, 2015 but IRB approval (Appendix A) to conduct the study was not granted until February 2, 2015. Therefore, the course had been in session for five weeks before I attended the class to recruit participants. At this time, I read the recruiting script which described the research, explained the separation of the research from the coursework, and offered to answer any questions the participants may have had. Prior
to signing informed consents, the participants were also informed that withdrawal from the research study would not result in any personal or academic consequences. Upon signing the consent form, participants were asked to provide their contact information so I could contact them to schedule the first interview.

Five preservice birth through kindergarten teachers who met the criteria volunteered to participate in this study. Four participants were in their second semester of the program and one participant was in her first semester. The four participants in their second semester were doing their second required practicum (9 hour field experience) while the fifth participant was doing her first practicum. This is an acceptable number of participants in qualitative research because there is no specific number rule for sample size in qualitative inquiry (Kvale & Brinkmann, 2009; Lincoln & Guba, 1985; Patton, 2002;), and small sample sizes are characteristic of qualitative research (Denzin & Lincoln, 2000) when the goal of investigation is depth rather than breadth. “The validity, meaningfulness, and insights generated from qualitative inquiry have more to do with the information richness of the cases selected and the observational capabilities of the researcher than with sample size” (Patton, 2002, p. 245).

The participants in this study were a relatively homogeneous group with respect to their demographic characteristics. They were all Caucasian, female, and in their early twenties. The highest degree earned by all participants was a high school diploma. Each expressed various reasons for entering the program - three were interested in becoming preschool/kindergarten education and special education teachers, one was interested in becoming an educational diagnostician, and the fifth participant was interested in pursuing a career in speech language pathology. Science courses taken by participants at the college level included biology, ecology, earth science, and physics. All of the participants commented that they took science courses
(biology, ecology, earth science) to meet curriculum requirements or as a mandatory prerequisite (physics) for graduate school.

Although the reasons for entering the program varied, they all shared a common desire of wanting to work specifically with young children birth to five years of age. I did not eliminate males or various ethnicities as potential participants. They were either not available or chose not to participate in the study. Although including a variety of participants with different genders, ages, and ethnicities would have been ideal, the limited number of volunteers that met this study’s criteria was a restricting factor.

To preserve anonymity for each of the participants, I assigned pseudonyms (i.e., Ava, Brooke, Claire, Diane, Ella) at random.

Data Collection

An overall strength associated with case study research is the use of multiple data sources, a strategy which enhances data credibility (Patton, 1990; Yin, 2003). Data sources that are typically associated with case study research are interviews, observations, and documentary analysis. However, unique in comparison to other qualitative approaches, with case study research, investigators can collect and integrate quantitative survey data which facilitates reaching a holistic understanding of the phenomenon being studied (Baxter & Jack, 2008). The data from these multiple sources are then converged or triangulated in the analysis process rather than handled individually. Each source becomes “a piece of the puzzle” and contributes to the researcher’s understanding of the whole phenomenon. Multiple data collection methods were used to thoroughly answer the research questions of this study. Data sources used were: (a) semi-structured interviews, (b) in-course and in-service learning observations, and (c) document analysis.
Semi-structured interviews. Teacher belief researchers commonly use semi-structured interviews to help gain in-depth understandings of the origin, development, and impact of teachers’ beliefs on their thinking and behavior (Fives & Gill, 2015). This focus on human interactions and situations make interviews an important source of information (Stake, 1995; Yin, 1994). In essence, semi-structured interviews can be described as “conversations with a purpose” (Dexter, 1970, p. 136). Although this is considered an unstructured format it is not unfocused, there is a guiding purpose (Patton, 2002). This method allows for “flexibility, spontaneity, and responsiveness to individual differences and situational changes” (Patton, 2002, p. 348). Disadvantages of this method include: (a) being more time consuming to collect systematic information, (b) posing difficulties in pulling together and analyzing information due to a wide range of responses produced during the conversations, and (c) being more susceptible to interviewer effects due to leading questions and biases (Patton, 2002).

For this study, I used an interview format Patton (2002) refers to as an ‘open-ended interview’ or ‘informal-conversational interview.’ Patton (2002) describes this conversational format as relying “…entirely on the spontaneous generation of questions in the natural flow of interaction” (p.342) but adds, “often as part of ongoing participant observation fieldwork” (Patton, 2002, p. 342). While interviews are an important source of information, it is essential that the gathered information be corroborated with other sources to its accuracy and reliability (Stake, 1995; Yin, 1994).

I conducted two semi-structured interviews with each participant. While it was my intention to conduct the initial interview before the course started, the final Institutional Review Board (IRB) approval was not granted until the course had been in session for five weeks (course start date was January 9 and study start date was February 6th). Therefore, the first semi-
structured interviews were conducted during the sixth and seventh week (mid-semester) of the course depending on the participants’ availability.

Before beginning the interviews, I reminded the participants their participation was voluntary and they had the power to withdraw at any time. I also explained that their names or other identifying information would not be used in the report and all participants would be randomly assigned a pseudonym. All interviews were audiotaped using a recording app on my iPhone and a handheld, battery operated transcriber. Both devices were positioned on the table along with the interview guide and participants were alerted as to when the recorders were turned on and off.

During the interviews, the interview guide (Appendix B) served more as references than as systematic guides to asking questions (Kvale & Brinkmann, 2009). This allowed me to focus more on the topics of the questions and view the interviews more as opportunities to construct knowledge (Mason, 2002) about the participants’ perceptions of their experiences in the course and connected service learning. I found this type of interviewing helpful in building an easy-going rapport with my participants. It also gave me flexibility to change questions depending on the participant’s responses, probe for deeper understanding and asking for clarifications, and allow participants to steer the direction of the interview (Denzin & Lincoln, 2000).

The first semi-structured interviews lasted 45 minutes to an hour and were conducted either at the early learning center or at the College of Education building. Demographic information, age and highest level of education, was also collected at the first interview. The second semi-structured interviews were conducted during the last week of the course and lasted between 35 minutes to an hour. Due to end of semester demands of course exams and projects, participants requested the interviews be scheduled the last week of the course.
I transcribed the interviews since “interviewers who transcribe their own recordings come to know their interviewees better (Seidman, 2013, p. 118). In order to protect each participant’s confidentiality, a pseudonym was assigned to each interviewee before transcription. The interviews were transcribed verbatim omitting non-word utterances (um, mmhmm). In an effort to protect all non-participating parties codes were assigned such as CM-classmate, II/I2-instructors, CT/A-classroom teacher or assistant, and PS-preschooler. To contribute to the trustworthiness and credibility of the report (Lincoln & Guba, 1985), participants were given the opportunity to review the data and reword responses or strike information from the transcript.

Observations. Unlike interviews, observations take place in the natural field setting and represent a firsthand encounter with the phenomenon of interest. Kidder (1981) defined observation as a research tool that: (a) serves a specific research purpose, (b) is planned deliberately, (c) is recorded systematically, and (d) is subjected to checks and controls on validity and reliability (p. 264). In teacher belief research, observations are often made of teachers in classroom settings to assess alignment between stated beliefs and actual classroom behavior.

I collected information as an observer as participant. Merriam (1998) describes the “observer as participant stance” as when “researchers observe and interact closely enough with members to establish an insider’s identity without participating in those activities constituting the core of group membership” (p. 101). Thus, this stance allowed me to observe in the contexts of my study and “function as a researcher” (Gans, 1982, p. 54). However, the more I observed, the more I felt like an insider and frequently had to remind myself of my purpose of being there and refrained from adding to conversations, discussions, or activities.

I found my observations supported and challenged the interview data, generated additional interview questions, thickened and enriched descriptions, and inspired me to reflect
more deeply. Initially, my observations were mostly holistic descriptions of the course and service learning sessions. However, as the course progressed, my observations became more focused and context-sensitive. Along with descriptive information, in which I documented the factual data, settings, actions, behaviors, and conversations/interactions, I noted reflective information as well. This included recording my thoughts, ideas, questions, and concerns as I made my observations. I transcribed the audiotapes from the observations and added my field notes to the reports so that important details and opportunities for fully interpreting the data did not get lost.

I observed and audiotaped eight course sessions (16 hours). Audiotaped course sessions were transcribed in the same manner as interviews – verbatim and maintaining anonymity through pseudonyms. I observed a total of six service learning sessions, two for each participant (some participants were partnered and they were observed simultaneously). Service learning sessions were observed during the 8th, 10th, 11th, and 12th week of the 13 week-long course (12 hours). The audiotaped service learning sessions were of poor quality and could not be transcribed due to the level of background noise of the children. When the nature club sessions were held outdoors other children were playing outside as well and the tapes were beyond comprehension. Therefore, for the service learning observations, I relied more on taking detailed observational and field notes.

*Documents.* Marshall and Rossman (2006) describe the review of documents as “an unobtrusive method, rich in portraying the beliefs of participants in a setting” (p.107) and as a “reliable source of data concerning a person’s attitudes, beliefs, and view of the world” (Merriam, 1998, p. 116). The documents reviewed for this study were lesson plans and considered a meaningful qualitative data source when triangulated with the other data sources of
interviews and observations. Lesson plans were examined prior to NEC service learning sessions and generated conversational topics during interviews. A total of eight lesson plans were reviewed.

Data Analysis

Data analyses began during the data collection process as qualitative research inherently means that data collection and analyses occur simultaneously (Miles & Huberman, 2005; Shank, 2002; Merrriam, 1998). Case studies do not use a predetermined set of guidelines during the research process, as Stake (1995) states “… the study is undertaken because one wants better understanding of this particular case … not because the case represents other cases…but because, in all its particularity and ordinariness, this case itself is of interest” (p. 88). Even if the nature of another study is similar, case study methodology rejects the idea of using the method of analysis from another study (Merriam, 1998).

In an effort to make sense of the collected data, I used thematic analysis as described in Merriam’s guide for category creation. I ensured the categories I created followed Merriam’s guide, in that themes were exhaustive, mutually exclusive, and sensitive to the data (Merriam, 1998). In addition, I conducted qualitative data analysis throughout the data collection process, including the initial and final stages.

Employing thematic analysis, I systematically coded my data and began turning my data into findings. Thematic analysis requires a researcher to search for common patterns in the data (Merriam, 1998; Shank, 2002). Morse explains, “…data analysis is a process that requires astute questioning, a relentless search for the answers, active observation, and accurate recall. It is a process of piecing data together, of making the invisible obvious…of correction and modification, of suggestion and defense” (p.25). During my research study, I consistently
remained immersed in the data. I regularly questioned and challenged my findings. In addition, I persistently reflected on both my data and the coding process as I coded interview transcriptions, observation transcriptions and field notes, and documents.

During the initial stage of conducting data analysis, I carefully read through the data multiple times, line by line. As I read through the data from the various sources, I identified themes as they emerged within the data, a process referred to as open coding. I also examined the repetition of key words and phrases in my data, which helped identify similarities across the participants’ experiences. After I identified major themes, as well as differentiated significant themes from insignificant themes as according to my research questions, I reread my data again. During additional readings, I revised the themes when necessary and identified prominent categories under each theme. I repeated this entire process again in order to confirm my findings and ensure that I had recognized all significant patterns and themes. Each time I revisited my interview transcriptions, observation notes, and documents, I refined the themes and categories. As I repeatedly read, I found that certain themes could be bundled together, while other themes needed dividing. I continued the coding process until my analysis reached a point of saturation. Additionally, I made a conscious effort to make sure my findings were reliable and valid by triangulating the multiple sources of evidence.

In addition to writing codes directly into the margins of my data transcripts, I used post-it notes to sort and organize data visually. Visually presenting data helped me see the structure of the themes and categories in addition to how they related to each other and supported my conclusions. Furthermore, as I created the post its, the data source was coded (e.g., I1P2 interview one with participant 2, OSL1P1P5 observation of service learning session for participants P1 and P5) which was helpful in demonstrating how much of my data sources
supported each theme. After thematically analyzing the data to answer RQ#1, using content analysis I deductively analyzed the data into the four predetermined categories of Bandura’s four sources of efficacy.

**Trustworthiness.** Trustworthiness is defined as “deserving faith and confidence” (Merriam & Webster, 2015). In interpretive, qualitative research, trustworthiness takes the forms of credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). In my effort to “establish the truth” (Lincoln & Guba, 1985, p. 290), I employed Lincoln & Guba’s (1985) four alternative constructs that more accurately reflect the criteria of a qualitative perspective.

**Credibility.** Naturalistic researchers address truth value through an equivalent concept referred to as credibility (Guba & Lincoln, 1985). Credibility is defined as the confidence that can be placed in the truth of the research findings (Holloway & Wheeler, 2002). Lincoln and Guba (1985) argue that ensuring credibility is one of most important factors in establishing trustworthiness.

Credibility for this study was established through the following strategies:

- **Triangulation,** as advocated by Patton (2001), “… strengthens a study by combining methods. This can mean using several kinds of methods or data, including using both quantitative and qualitative approaches” (p. 247). The multiple data sources in this study enhanced the interpretive status of the evidence. Complementing the interviews with prolonged and persistent observations helped ground the study in the lived experience and context of the participants and added to the “truth value” of the evidence. Document analysis provided additional information that when converged with the interview and observation data enhanced the credibility of the study.
- **Member checking** means that the “data and interpretations are continuously tested as they are derived from members of various audiences and groups from which data are solicited” (Guba, 1981, p.85). Lincoln and Guba (1985) posit that this is the most crucial technique for establishing credibility. In this study, participants were offered opportunities throughout the study to review interview transcripts and expand on or explain their responses.

- **Prolonged engagement** in field or research site refers to the researcher immersing themselves in the participants’ world (Bitsch, 2005). Krefting (1991) asserts that “extended time period is important because as rapport increases, informants may volunteer different and often more sensitive information than they did at the beginning of the research project” (pp. 217-218). My frequent presence during class sessions allowed me to become an accepted member of the class and made my presence during NEC sessions less obtrusive. This strategy allowed me to gain valuable insight into contexts the participants were “living” within and decrease the distance and increase the rapport between myself as a researcher and my participants. I spent a total of 28 hours in the field (16 hours class time and 12 hours service learning NEC sessions).

- “If prolonged engagement provides scope, **persistent observation provides depth**" (Lincoln & Guba, 1985, p. 304). Persistent observation is a technique which ensures depth of experience and understanding and is accomplished through prolonged engagement. Persistent refers to the researcher exploring details of the phenomena under study to a deep enough level that he or she can decide what is and what is not important (Lincoln & Guba, 1985). The familiarity I gained
through persistent observation allowed me to focus on the relevant aspects of the contexts and participant characteristics.

- Peer debriefing as describe by Guba (1981) “provides inquirers with the opportunity to test their growing insights and to expose themselves to searching questions” (p. 85). Throughout the data gathering, analysis, and interpretation stages, I sought the support from an impartial colleague who had experience with qualitative research. Having a peer (or at times a “devil’s advocate”) challenge my assumptions and offer a different perspective made me open my eyes to my own posturing and biases making me a more reflexive and reflective researcher.

Transferability. Transferability, or applicability, refers to the degree to which the results of qualitative research can be transferred to other contexts with other respondents (Lincoln & Guba, 1985). In traditional research, the concern often lies in demonstrating that the findings can be applied to a wider population. However, in qualitative research the small number of participants in particular environments, makes it impossible to demonstrate that the findings and conclusions can be applicable to other situations and populations. Bassey (1981) proposes that, if practitioners believe their situations to be similar to that described in the study, they may relate the findings to their own positions. Lincoln and Guba (1985) and Firestone (1993) present a similar argument, and suggest that it is the responsibility of the investigator to ensure that sufficient contextual information about the fieldwork sites is provided to enable the reader to make such a transfer. They argue since the researcher knows only the “sending context” (Lincoln & Guba, 1985, p. 297), he or she cannot make transferability inferences.
According to Guba (1981) thick description helps others researchers replicate the study with similar conditions in other settings. Shenton (2004) argued that “without this insight [thick description], it is difficult for the reader of the final account to determine the extent to which the overall findings “ring true” (p. 69). Therefore, by providing sufficient thick description of the phenomenon I investigated, I facilitated transferability. The detailed descriptions of the research context, processes, participants, and researcher-participant relationships enabled potential readers to decide how transferable the findings may be to their situation. Another strategy I used to enhance transferability was purposive sampling. Purposive sampling allowed me to focus on recruiting a small sample of informants who were particularly knowledgeable of the issues I was investigating (Patton, 2002). Lastly, I made no claims as to the generalizability of the findings of my study upon others (Patton, 2002) - that I have left to the reader.

Dependability. Lincoln and Guba (1985, p. 300) use “dependability” in qualitative research which closely corresponds to the notion of “reliability” in quantitative research. To address issues of reliability, positivist researchers use techniques that show if the study was repeated, in the same context, with the same methods, and the same participants, similar or same results would be obtained. However, Marshall and Rossman (1999) state that the changing nature of the phenomena scrutinized by qualitative researchers renders making such obligations problematic in naturalistic studies.

Recognizing the difficulty in reproducing social phenomena, dependability is addressed directly through the processes within the study. In-depth and detailed reports enable future researchers to repeat the study as well as assess the extent to which proper research practices
were followed. While the same results may not necessarily be gained, the research design may be viewed as a “prototype model” (Shenton, 2004, p. 71).

The dependability of this study was enhanced through what Guba (1981) termed auditable. I provided in-depth descriptions of the data gathering, analysis, and interpretation processes which another researcher can clearly follow and judge how repeatable the study might be. Other strategies I used to enhance dependability as recommended by Lincoln & Guba (1985) and as described above included triangulation, peer examination, and repeated observation of the same event.

**Confirmability.** The concept of confirmability is the qualitative investigator’s comparable concern to objectivity. Guba (1981) viewed neutrality not as researcher objectivity but as data and interpretational confirmability. Therefore, qualitative researchers must take steps to ensure that the findings are the result of the experiences and thoughts of the participants, rather than characteristics and preferences of the researcher. I used three techniques recommended to ensure confirmability. The first technique was triangulation of multiple data sources. Guba (1981) recommends an investigator should provide documentation for every claim or interpretation from at least two sources to ensure that the data support the analysis and interpretation of the findings. The second technique I used to enhance neutrality was admitting my own predispositions (Miles & Huberman, 1994). In the following section I acknowledge that I am not a neutral researcher and disclose my biases and assumptions. Thirdly, as recommended by Lincoln & Guba (1985), I maintained a reflexive research journal where I continuously documented the research processes. Keeping this “diary” helped me reflect critically on my practices as a researcher and contend with the “pesky” issue of bias and other unintentional influences.
Researcher Bias and Assumptions

I believe many teachers in today’s preschools struggle with how to teach science to young children. My background as a special education teacher co-teaching in inclusive Head Start and prekindergarten classrooms for seven years has led me to this belief. In my own experience, I have co-taught with outstanding prekindergarten teachers who are passionate about preparing young children for their lifelong journeys of learning. However, many have struggled with providing quality experiences that prepare young children on the road to becoming scientifically literate.

My bias is that all preschool teachers should know how to teach science to young children. At an early age, children have the capacity and propensity to observe, explore, and discover the world around them (NSTA, 2014). Preschool teachers need to encourage and support these basic skills and begin laying the foundation for future science learning. However, in my many years of co-teaching, some of my co-teachers have candidly shared their reasons for neglecting to teach science – lacking confidence because they don’t know “what science looks like at this age,” not considering science an important readiness area regardless of early learning standards being in place, or disliking science based on their own personal experiences. These thoughts have prompted me to explore how a teacher preparation program teaches prospective birth through kindergarten teachers in becoming efficacious science teachers.

I assume we all share a common belief that we will avoid doing things that are “out of our comfort zones.” I assume that my participants have a true desire to learn how to teach science in their future preschool or kindergarten classrooms. I assume the fields of early childhood education and teacher preparation are interested in learning how to prepare teachers to
teach science to young children. I assume all children should become scientifically literate citizens.
CHAPTER 4

FINDINGS

The purpose of this study, conducted within the context of a science course with connected service learning, was twofold. First, using thematic analysis, I inductively analyzed the experiences preservice birth through kindergarten teachers reported as influencing their self-efficacy towards teaching science. Secondly, I deductively analyzed and aligned the reported influences with the predetermined categories of Bandura’s four sources of efficacy. Data sources used to answer the research questions were semi-structured interviews, observations, and document analysis.

In this chapter, I have organized the findings of each research question by overarching themes and categories. In the first part of this chapter, I will focus on answering research question one. To explicitly expound on the themes, direct statements and words from the participants have been italicized throughout the report. Codes specifying data sources have also been used: interview 1 (I1), interview 2 (I2), service learning observation (SLO), and class observation (CO). I will then focus on answering research question two. To demonstrate how the chapter will unfold, an overview of the coding schema with major themes and categories for each research question is illustrated in Table 1.1.
The first question I sought to answer was: How do preservice birth through kindergarten teachers perceive their experiences in a science course with connected service learning influenced their self-efficacy towards teaching science? Two overarching themes emerged when categorizing the analyzed data: course experience and service learning experience.

Course Experience

The preservice teachers’ statements of the experiences that influenced their self-efficacy towards teaching science were categorized as learning and relationships. In the paragraphs that follow, each of the categories and subcategories will be discussed, along with representative statements from the preservice teachers. However, although each category is discussed separately for clarity purposes, there are many intersections among the categories experiences. This section will illuminate how the course experiences influenced the preservice teachers’ self-efficacy towards teaching science.

Learning. In order to integrate the science-related course content and service learning experience, the service learning experiences were integrated into course discussions, reflections, and assignments. The preservice teachers actively participated in discussions focused on science
content intentionally connected to a service learning experience, the Nature Explorer Club (NEC). They also planned science-related lesson plans with their peers utilizing strategies modeled in class by instructors. In addition, the class served as a forum for students to reflect on their NEC experiences and how the authentic science teaching experiences related to course objectives. Participants reported all of the experiences within the context of the course influenced their self-efficacy towards teaching science to preschool-aged children.

Discussion. The experience of communicating and interacting during class discussions made preservice teachers’ more comfortable with the thought of teaching science to young children. Through class discussions, preservice teachers realized what science teaching and learning is at the preschool level. Brooke expressed she was apprehensive going into the course because when she thought of science, she thought of physics and chemistry. She now “thinks differently about what science is.” Understanding science learning can occur through activity-oriented approaches such as gardening, she feels the thought of teaching science is “less scary.” Diane and Ella also expressed how becoming more mindful of what science is in preschool increased their comfort levels:

At the beginning, I don’t think I really had any idea because my idea of science was like middle school science fair and that was just a nightmare in my house. But, now it is like I have an idea of it. It’s like explorations and guiding. (Diane, I1)

At first, when I heard science I thought, ‘I am not a science person. I’m more math and creative arts’ like so it was kind of really scary. But realizing like using nature, that’s a good start with this age and developmentally appropriate for teaching science. Realizing that this is science for this age ... I’m comfortable with that. (Ella, I1)
Group discussions and assignments were designed to provide science content knowledge appropriate to meeting young children’s questions and experiences associated with nature and natural phenomena. At the beginning of the course, Claire stated, “I realized I literally knew nothing...you know, I didn’t even know like basic things.” During a class discussion, she stated her increased science knowledge made her feel more confident in her ability to enter a preschool classroom and not misinform her students about science subject matter such as the parts of a plant or parts of an insect (CO). Diane also remarked learning the content before having to teach the lessons made her feel more confident towards teaching science (CO).

It was during class discussions when preservice teachers were observed becoming aware of science misconceptions they unknowingly possessed (CO). For instance, two preservice teachers co-wrote a puppet show to introduce insects to the preschoolers and mistakenly cast a spider as an insect. Although they were slightly embarrassed and had to re-plan the lesson, their classmates confessed they did not know spiders were arachnids and not insects either. This learning experience served as a valuable opportunity as studies have shown that in elementary grades, students are likely to have teachers who have science misconceptions and are not aware of them (Burgoon, Heddle, & Duran, 2010; Stein, Larrabee, & Barman, 2008). The following week, the same preservice teachers were observed re-presenting the lesson starring crickets and stated they had used a reliable website to research how crickets made chirping sounds by rubbing their wings, not their legs, together (CO). While reviewing the revised lesson, Ella commented, “Well, after the spider’s not an insect thing, we learned to check our facts.” This experience prompted Brooke to self-evaluate the adequacy of her own science knowledge. She was astonished to realize her level of science knowledge was inadequate, “I know I don’t know a lot of science but I thought I knew preschool science! So embarrassing, a spider is not a bug. I
mean insect. I’m glad I know that now!” Class discussions also informed preservice teachers to be cautious when using children’s literature to teach science content (CO). For example, a popular children’s book used as the basis of a puppet show held inaccurate content related to the life cycle of a butterfly. When performing the puppet show, the preservice teachers corrected the word cocoon to chrysalis.

Other successful learning experiences preservice teachers reported as influencing their confidence towards teaching science were in terms of understanding teaching strategies and facilitating developmentally appropriate science learning experiences. Having a clear picture of developmentally appropriate science teaching and inquiry-based learning increased Diane’s confidence. She stated, “I know they need to learn hands-on and talk about what they are thinking and how they can learn through using their senses instead of ‘sit at your desk and do a worksheet.’” (Diane, I1).

Several preservice teachers predicted they would use the newly learned strategies in their own future classrooms to teach science. For instance, although Claire had never seen or used puppetry as a teaching tool, after seeing the preschoolers’ reaction and engagement during the puppet shows, she now feels confident in that she “will definitely consider using puppets in [her] own classroom” to teach science. Brooke also mentioned while she has never been a fan of puppets, she now views puppets as “a great [instructional] tool.” Through her experience, she too realized how “hugely beneficial” puppetry is as a teaching tool with young children and stated will seriously consider using puppets to teach science in her prospective classrooms. Ava stated her experience taught her the importance of integrating live organisms into the science topics she will be teaching to preschoolers:
This class definitely did make me think more about how the topics can be covered. It was great bringing real insects into my class. The kids were more engaged in learning because they were like “Oh cool, close up real bugs.” So, using real-life stuff makes a difference. (Ava, I2)

Preservice teachers also began realizing how science activities and explorations provide a rich context for children’s learning in other areas and how science learning connects to the broader curriculum. During a class discussion, Claire explained how she was able to extend her questioning by integrating early math concepts into the observation of butterflies (CO). After identifying the parts of the butterfly, she asked them to count their legs, compare them in size, and look for patterns on their wings. Brooke expressed a similar understanding,

I’m learning you can just embed like so much in science. You can do your literacy, you can do your math and so they [preschoolers] are connecting like all those concepts. I think it’s cool to learn that but really good to practice it. (Brooke, I2)

Lesson Planning. Within the course, students were primed by course instructors to successfully prepare lesson plans designed to teach science through gardening and nature-related topics. All of the preservice teachers reported this experience significantly increased their confidence in their ability to plan and implement science-related lesson plans. This was evidenced by the following participant statements:

I do love how it started out where we were like given the lessons and now we are making half of the lessons and then I think our final lessons are due and then eventually we will implement our own and each other’s kind of thing. So, I have really loved how that was set up just because that has helped me get more comfortable. It wasn’t like ‘okay here plan your lessons and then try to do it.’ I think I would have been
overwhelmed. Like, I said I am not crazy about science and stuff like that and it is new to me. But that part has been really beneficial. (Brooke, I2)

The way they built on us doing the lesson plans [NEC lessons] was very helpful. I feel like when I was doing the first one, I was like ‘I don’t know what to do, I don’t know what I’m doing’ but I did. They didn’t just throw us in and be like ‘okay go do whatever.’ That really helped set the tone and helped how it has gone this whole time. So, them showing us what is expected has been incredibly helpful because if not I would have been just like [makes a groaning sound]. (Ava, I2)

In addition, all of the preservice teachers identified developing lesson plans and demonstrating them in front of their instructors and peers as experiences that further enhanced their confidence towards teaching science. Ava stated these experiences impacted her confidence to teach science the most. Using the science early learning standards, she believes she now has the ability to design quality lesson plans to teach various age-appropriate science topics. She expressed she now “gets” how early learning standards support and guide teachers in developing science lesson plans that are appropriate and of interest to young children. The following statements further support the positive influence of this experience:

I feel like now I have more knowledge of the subject [science] and doing the lesson plans towards the end like that was pretty cool because we put all the thought into the activity and we knew it really well. So that helped my confidence a lot. I just felt like ‘okay I’ve got this’ and more in my comfort zone. (Ellie, I2)

I loved about how we talked about the future [science] lessons. Instead of just ‘here is the lesson plan,’ we had time to prepare ourselves which was another thing that boosted my confidence. (Claire, I2)
The feedback is important. Ultimately, you do it [science lesson] in the classroom but it is so much better to do it like practice and get someone to critique it. (Brooke, I2)

I think feedback from everybody is good. Most of us get in our heads, well, we create a lot of like arts and crafts stuff and then it helps a lot to talk it out and maybe this won’t work because even though it’s fun, it’s not what I’m trying to teach. (Diane, I2)

Planning lessons is a fundamental duty of teachers. Given that early childhood programs base their instruction and assessment on what is outlined in early learning standards, these experiences are fostering their ability to use the standards as they are intended.

Reflection. Within the course setting, reflection was used as a valuable learning experience to “dissect” and analyze the NEC authentic science-teaching experiences. All but one preservice teacher reported this experience as strongly influencing their self-confidence towards their ability to teach science as evidenced by the following statements:

…it help[ed] me reflect a couple of days later because you’re not so much in the moment and you can think more clearly about what went well and what didn’t. (Brooke, I1)

It’s nice to talk to people and not just decide on your own. You would second guess yourself a lot. So there was like a team effort in learning really. (Ellie, I1)

However, on the contrary, one preservice teacher reported the reflective experience had no influence on her confidence towards teaching science. She stated she had already talked to her classmates during classes or through social media throughout the week about her NEC experience and her groups were “crazy anyway.” When probed further, she just stated, “I just didn’t get much out of it.” (Ava, I2)

Several preservice teachers reported they found the reflective experiences comforting as it presented an opportunity for them to share about their service learning experiences. As one
participant described, “Oh this was so, so comforting to me. It was just nice to hear that other people were struggling like with the same things I was” (Diane, I2). Upon hearing about others’ experiences, the preservice teachers externalized the struggles to challenging circumstances such as large class size and/or unsupportive classroom staff versus internalizing them, thus questioning their own science teaching capabilities. This was evidenced by the following statements:

*I would say the reflecting part helped my confidence because it was after [NEC] and it was like ‘Oh okay, so it wasn’t just our class that it happened in.’ You know, like all the other classes were having those issues too. So the reflections were good.* (Brooke, I2)

*Well, I think it was just nice to hear that other people were struggling like with the same things I was, you know. I really like reflecting about how our lessons went because mine went so bad. Like, if I hear someone else be like ‘I think mine went bad too,’ then you know they’re in the same boat as you. If they say, ‘well, my kids won’t listen’ then, I’m like ‘Oh good, then it’s not just my kids, I thought it was just me.’* (Claire, I1)

*It is very helpful actually. Because when we started this none of us really knew what we were doing. So, it is nice to hear from your peers, what is going wrong in their classes, and knowing it’s not just you.* (Ella, I1)

The same participants further reported reflection experiences were beneficial because they led to collaborative problem-solving which helped them view struggles as learning opportunities. One participant reported the reflective sessions as the most influential experience during the course and stated, “I love the reflecting and that’s one of the times that I am getting the most out of it [the course]. It helps to hear what others think and I learn from that” (Brooke I2). This was further evidenced by the following statements:
…it’s nice to hear how they are fixing it and nice to present your problems, not just to your teachers, but everyone around you. I learned a lot when they were like ‘Oh, we had that issue and we did this.’ (Claire, I1)

The fact that people can say that ‘this went wrong’ instead of everyone going like ‘mine went great, mine went great.’ Hearing what did work and bouncing ideas off each other about what worked and what didn’t work, made me think that’s how you learn to really teach. (Diane, I1)

…if we weren’t coming back and explaining and talking, I feel like we would just do our nature club and be like ‘Oh my gosh, that just went like [blah expletive]!’ and then do it again next week, and not really think about it. Just go home and take a nap, you know. So, that was good that we did that, it made me remember that this is a learning process for me and the ideas and help I get from others helps me to keep going. (Brooke, I1)

They would give us ideas, like ‘I did like this and this’ and we would be like ‘good we’ll steal that and try that next week.’ (Ellie, I2)

The collaborative problem-solving observed during reflective sessions were observed being implemented during NEC sessions (CO). For instance, two preservice teachers struggled with finding enough time to work journaling into their science lessons, and fellow participants shared they had the same problem and recommended using it as a transition activity (CO). The offered suggestion was observed being implemented during their observed NEC session and it went successfully – “So, that was a good transition with the journaling, do you want to do it the same way with our next group (Ava, SLO)? Yeah, that was smooth (Ella, SLO).” Other strategies preservice teachers discussed during class and were observed utilizing during NEC experiences were ad-libbing science-related questions into puppet show scripts (SLO),
reinforcing science vocabulary during activities (“Now, what did Suzie (puppet) call this?), and giving more concise, one-step directions (SLO). Through these experiences preservice teachers became more conscious of the multifaceted nature of teaching and learning. In addition to knowledge of science subject matter, preservice teachers realized how they also need knowledge of organizing the learning environment and handling classroom management problems.

Course Relationships

Instructors. The course was well thought out by instructors and careful consideration was given to the course’s learning activities such that academic and experiential learning experiences were well integrated. Class observations revealed a relaxed and comfortable classroom atmosphere which enhanced student motivation and active participation (CO). Because inquiry-based science teaching was a new experience for the preservice teachers, instructors provided a lot of nurturing, modeling, and reinforcement. During discussions and activities, the instructors provided sensitive feedback to the students and encouraged critical reflection and analysis by often answering questions with questions. The instructors were frequently observed complimenting the students on their ideas, efforts, and persistence (“I am really proud of how well all of you are doing with learning how to adapt and differentiate [the science lessons]”, “Let me just say you did an excellent job on the [parts of an insect] lesson plan and activities so let’s talk more about …” (CO). Two participants reported the nonjudgmental, nonthreatening class experience increased their confidence by putting them more into their “comfort zone” – “In class, I felt okay talking about it [teaching science] because I wasn’t being judged. They [instructors] made me feel more like you’re okay, we’re all learning” (Claire, I2). This was also evidenced by the following statement:
It is good to know that you have teachers that don’t make you feel self-conscious about it (referring to teaching science content using puppets) and are willing to do whatever so you’re more likely to say ‘okay, so I guess it’s okay. Maybe I can do it.’ (Ava, I1)

Peer. Many of the participants found the course experiences brought them closer together as a cohort which, in turn, influenced their confidence. They described mutually beneficial relationships were fostered through the course’s collaborative activities and they were not only receivers of information but also givers of information. Some participants reported that throughout the class interactions, they saw themselves in their peers, convincing them that they had the skills and abilities to successfully teach science.

During class and NEC observations (CO, SLO), participants often complimented each other’s ideas for science-related lessons and/or observations they had made of each other while teaching. In one instance, a classmate complimented one of the participant’s ability to calmly manage her preschoolers while engaging them in a planting activity on the playground (SLO). A second instance was when Ava and Ellie performed the puppet show they wrote about insects benefiting the environment (CO). Their peers complimented the “kid-friendly” approach they used to explain how insects are useful to the environment and the instructor complimented their use of repetition as a teaching strategy. This was further evidenced by other preservice teachers’ statements,

I’m more comfortable with all of them [peers] and like we are all in the same boat kind of thing. They really helped me out sometimes and then if I learned something like I would tell them … like they had a little guy who never listened and I told them to give him helper jobs to keep him with the group… Kind of like I know you can do it and they make me feel that way too. (Ava I1)
I feel like I’m closer to them [cohorts]. It’s more fun to like plan the lessons with everybody and hear all of our ideas together. We’re so new to this and I think the kids are learning some science stuff from us. (Claire, I2)

Learning the act of planning and working together is a powerful skill in the teaching profession. It is one which preservice teachers are expected to know about and demonstrate the capacity to do when they enter the teaching force (Michael & Miller, 2011). Moreover, the art of collaboration was well demonstrated by the course instructors and gave the preservice teachers a glimpse of collaboration in action.

Service Learning Experience

The Nature Explorer Club (NEC) was the weekly service learning experience connected directly to the course. This authentic teaching experience afforded preservice teachers an opportunity to implement the class-prepared science lesson plans and apply the strategies and techniques learned and practiced within the course. As stated earlier, while each category is discussed separately for clarity purposes, many intersections among the categories exist. This discussion will illuminate how the service learning experience influenced the preservice teachers’ self-efficacy towards teaching science. After carefully analyzing the data, the overarching theme, service learning experience, included two major categories of teaching and relationships.

Service Learning Authentic Teaching Experience. Some preservice teachers reported the service learning experience, teaching the nature club lessons, had a positive influence on their confidence and ability to teach science. Claire felt having repeated opportunities to lead a class and present herself as the teacher built up her confidence feels she can comfortably lead a science lesson. She stated,
I really think I could teach in a classroom the things that I have learned from doing this. Before like in practicums, it was just implementing a lesson plan maybe once every month like me reading a story but not like this. This was ‘Hey I’m Ms. ____ and this is what we are doing today.’ Like you know being a real teacher. (Claire, I2)

Diane felt having to teach each week built her confidence as well. Through authentic teaching, she realized her personal science learning experiences as a young student influenced her confidence towards teaching science to young children,

I mean at the first nature club, I was like so nervous and like this is going to be a train wreck. I [didn’t] know what I [was] doing. But, now I just feel like I am much better at it. It’s just like my earliest science thing that I can remember from first grade where we went outside and we had to find something we could look at, touch, smell, taste, and hear and we had to write them all down. Like we did the senses stuff and that’s how you really like teach little kids science. (Diane, I1)

Furthermore, when Diane reflected on her NEC teaching experience, she frequently attributed her increased confidence towards teaching science to the teachers and preschool classes she was assigned,

I’m just so much more comfortable with at least how my groups were. If I had a crazy group I don’t know if I would feel the same way but...some of them had big groups and I just feel so much better because of my groups. Oh, my gosh, [my teachers] were awesome and I totally loved having their classes. (Diane, I2)

In order to provide the learning experience to all three and four year olds enrolled at the center, regular preschool or prekindergarten classes were combined with smaller special education classes. Consequently, class sizes ranged between approximately 17 to 33 students who were
accompanied by approximately five teaching staff members. During both service learning observations (first group 22 prek students, 7 special education students, and five staff members; second group inclusion class 17 students and 2 staff members), the cooperating teachers were supportive and demonstrated effective classroom management skills thus creating an atmosphere where science inquiry learning could take place (SLO).

Ellie also perceived the NEC teaching experience increased her confidence and ability to teach science. She credited this increase primarily to her experience teaching her second group because it was a manageable size (approximately 13 preschoolers and 2 teaching staff members) and the teaching staff members were supportive and engaged: “Yeah, my second group is so much better and I really like the teachers. I am less stressed and I think they [preschoolers] actually learned about nature and planting.” This experience significantly contrasted to how she described her experience with her first group of students:

*I would say that when we have a class like that [approximately 20 prek and 9 special education preschoolers] trying to find ways to get the teachers [5 teaching staff members] more involved because we only see them [preschoolers] once a week so, we don’t know their names and we don’t know like what is going to make them do the correct behavior. Like how to redirect them in a way that will make them do the right thing. And a lot of the activities we split up and the teachers did some of the activities while we did the others which helped. But, when it came down to like dealing with the kids who were out of control, we didn’t have like any support. So, I felt like I was very much out on my own and having to deal with like these things that I really don’t have the experience for or am I qualified for yet. Like, I just really didn’t know what to do and it was harder to like teach them.* (Ellie, I2)
Yet, regardless of these unfavorable experiences, Ellie’s confidence in her science teaching grew:

*I think I definitely became more confident. I really feel like I learned a lot along the way, even though I had my ups and my downs for sure. You’ve seen our class. They [second group] were really hectic so, it was a bit of a downer when you don’t see the changes first hand, but I do feel more confident in my teaching regardless of how the kids responded to it. I feel like I have more knowledge of the subject and what I am doing. So, that helped my confidence a lot.* (Ellie, I2)

Brooke reported similar NEC experiences as influencing her self-efficacy toward teaching science. She reported unsupportive teaching staff overshadowed her teaching experiences as well:

*That’s the one part of it I question, like the teachers. I think they thought it was like a break for them and it would get like really chaotic and they would just like look at us like ‘do you even know what you’re doing?’ I think if it was more of a collaborative thing it would have been better, like, because they’re a teacher and I’m a student teacher.*

(Brooke, I2)

However, Brooke felt teaching her second smaller group (approximately 16 preschoolers) increased her confidence towards teaching science because she had a “*deeper experience of teaching science*” in comparison to her first group (approximately 22 prek students and 8 special education preschoolers). This was evidenced by her following statements:

*Like, the self-contained [special education] class has four teachers and there are four teachers with the other class and all these kids and it gets a little rowdy. We always get through it and it’s always fun but sometimes I wonder if they are really understanding*
like that there is a point behind, like the kids, are understanding like ‘oh we learned about worms today.’ It’s hard for us to get to explain that the worms live in the soil and... Then our second group is 17 maybe even less, 16 or 17 three and four year old Head Start kids, and I always feel like it always goes smoothly especially when we get to break up into four groups and have them rotate between two of those groups. (Brooke, I1) I feel like they are getting it more because of they are a smaller group. But, just the experience it has given me. I feel like my experiences are richer in that second group in that I feel like I am teaching better and the kids are responding better so... (Brooke, I1)

During the interviews, she would frequently return to this subject and describe how her attempts to teach science made her feel and how she eventually came to terms with it:

Yeah and that [NEC teaching] was especially hard but I don’t think I will ever have 22 pre-k students and 12 special ed. kids together. And, like in my own classroom, I don’t think they will be running all over and pulling all of the stuff down. (Brooke, I2)

Um, well like I said before, it was like ugh! But, I did fine and now I’m good. I think in general though, that when I have to do things that I am not really knowledgeable about and wish I was more ready to do it, I get really nervous, and I like just get scared that I will mess up. So, that part of it [teaching NEC], I got a little stressed from it but I just took a breath and said, ‘You’ll be fine, you’re not going to die.’ (Brooke, I2)

However, in the end, Brooke reported her teaching experience taught her the importance of teaching science to young children, especially children from low income households, and made her feel more comfortable towards teaching science: “So, I do think it [science] is necessary. I think the classes did teach me that which is good. And like right now, I think I am comfortable with it [teaching science]. (Brooke, I2)
Regrettably, Ava reported her NEC teaching experience had no influence on her confidence towards teaching science. She reported group sizes and unmanaged children interfered with her efforts to engage the preschoolers in the science lessons and never actually felt like she taught science,

*I don’t know, I just don’t think I got too much out of it [NEC teaching] except maybe working on my classroom management skills. But as far as actual like how to teach science, I just didn’t get that much out of it. The kids were just so hard to teach. I was really doing more management than teaching. But, I did try and ask every child questions and get them interested.* (Ava, I2)

**Service Learning Relationships**

NEC Partner. All of the preservice teachers reported co-teaching the science lessons with a partner significantly increased their confidence towards teaching science,

*If I didn’t have my partner, I couldn’t have gotten through this. Like if either one of us was freaking out, we would be like ‘okay just chill, let’s talk this out.’ It was just very comforting to have someone on the same level having to do it with you.* (Ava, I1)

*I don’t think I could do this all alone. I think it is nice to bounce [ideas] off each other. Yeah, I can just look at her and just use cues, like we don’t have to say anything, it’s just a lot easier. And if she’s not getting the kids’ attention, I will get it and if I’m not, then she will get it. It’s just so much easier with a partner.* (Claire, I1)

The fact that they [classroom teaching staff] weren’t particularly involved was like ‘okay,’ so me and [my partner] were like “we will do this together, so let’s go!”

(Brooke, I2)
Nature Explorer Club observations of preservice teachers corroborated these statements of collaboration (SLO). Together, the preservice teachers were observed taking ownership of the science teaching task and encouraging each other towards their common goal. While teaching the science lessons, preservice teachers not only supported each other but also observed and provided evaluative feedback to each other. This was evidenced when Claire acknowledged how her co-teacher used the preschoolers’ background knowledge about tools before introducing tools commonly used by scientists to do investigations (SLO). Another instance was when Ava observed her peer co-teacher asking the students to recall what they had learned the week prior about the parts of a plant before showing them how to plant them. Ava told her partner that she saw how introducing the planting activity with a review focused the preschoolers’ attention on the plant before settling into the planting activity. Ava was observed successfully using this approach with her second group of students (SLO). When harvesting radishes with a large group of preschoolers, Diane observed her co-teacher managing a large rambunctious group of preschoolers by getting them to work in pairs. After pairing up her group, the preschoolers Diane noticed how cooperative learning promotes student involvement and engagement to science learning.

The preservice teachers reported collaborative experiences also made them confident in the ability to successfully differentiate science lesson plans to meet the needs and learning styles of their preschoolers. Ellie felt she and her partner’s confidence increased because they observed how the modifications they made to the lessons plans decreased adverse behaviors and increased student learning. She stated they identified several of the preschoolers in their groups as tactile learners and when teaching outside allowed the preschoolers more freedom to explore the grass and nearby plants. During a service learning observation (SLO), they were observed
accompanying the preschoolers on their explorations asking them questions about plants and flowers that interested them. Ava also felt more confident towards teaching the science lessons to her preschoolers because she felt more confident in assessing the learning styles of her preschool students and modifying the activities accordingly,

*Over time, we figured out what would work and what wouldn’t work for our classes and even though we were handed lesson plans and given exactly what to do, we would modify them to fit our kids better which helped a lot. That’s something I think we were good at. Making them fit.*

Other preservice teachers expressed similar feelings of increased confidence in their ability to adapt lessons while achieving the same learning objectives. This was exemplified by Ellie and her partner substituting real-life pictures of vegetables for clipart pictures,

*We had an activity that was sorting different pictures [clipart] of vegetables like ‘this is a root, this is a stem,’ and we were like ‘hmmm, this is probably not going to work too well with these kids’ so we took pictures of the real life versions of the vegetables and the kids were like ‘I’ve seen that, I know those.’* (Ellie, I1)

The preservice teacher whose partner withdrew from the class was initially nervous about not having a consistent partner to co-teach the science lessons but realized the benefit of having multiple partners. She was able to observe several classmates teaching science during NEC sessions and "learned from their perspectives" and "stole their ideas." During NEC observations, she was observed applying the “stolen” instructional approaches and class management ideas into her own science teaching (SLO).

*Instructors.* Preservice teachers were observed teaching science to the preschoolers by the clinical instructor during the first or second nature explorer session and again during the final
science lesson, the culminating garden party. Preservice teachers highly respected instructor feedback and believed it improved their science teaching. Diane (I2) reported she found having an instructor present during her first authentic science teaching experience “comforting.” She further stated, it “was helpful just because I was like ‘I really didn’t know,’ so, just to really have her there just over my shoulder, just coaching me through it, was really helpful.” Ellie was observed teaching her first nature club class and felt the feedback she received from the instructor benefited her ability to teach science:

> Like my first week, everyone was nervous and in between the two classes, the [instructor] was like ‘Hey, maybe you could be a little bit more confident and use a stronger voice.’
> And I was like ‘okay.’ So, I used that for the next lesson and it went better. (Ellie, I1)

Brooke also commented on how she values instructor feedback. She remarked that while being observed makes her nervous, she understands the significance of it and wished she had received more feedback on her authentic science teaching performance,

> I like it when she comes out to practicum and observes my lesson plan and tells me ‘you did a great job of constantly engaging the kids. You maybe need to work on your phrasing’ this kind of thing. You know, it’s nice because its things I don’t think about, some of the things she tells me. So, like “oh right.” It’s hard and ultimately you learn it in the classroom, but it is so much better to do it like practice and get someone to critique it. (Brooke, I2)

Claire also remarked the authentic science teaching experiences would have impacted her confidence more if she had received consistent feedback from inservice teachers or instructors. While she and her partner evaluated their science teaching performances and skills, she was not sure if their self-assessments were accurate:
It would have been awesome if the classroom teachers critiqued us but they didn’t. So, maybe it would have been nice if the [instructors] came more often, at least one of them, to see and make sure we were doing them [lessons] right because we were like “did we do a good job or do you think that was just chaos?” (Claire, I2)

Classroom Teaching Staff. The participants’ authentic science teaching experiences were observed to be significantly influenced by two factors related to classroom teaching staff. The first influencing factor was the varying levels of support classroom teaching staff provided preservice teachers. Preservice teachers with supportive classroom teaching staff reported higher levels of comfort and confidence in their science teaching capabilities.

During NEC observations, some classroom teachers were observed supporting the science learning process by facilitating the learning environment, managing their students, and actively engaging in the nature club (SLO). They modeled effective science teaching methods (e.g., guiding explorations, asking questions, using science-related vocabulary), effective behavior management, and enthusiasm. For instance, some teachers were observed reviewing “good audience manners” with their students (e.g., sitting quietly, listening when preservice teachers were talking, raising their hands to ask questions or make comments) before the lessons, strategically sitting students or grouping students to minimize behaviors, and using wait time to review science concepts learned in previous NEC sessions (SLO). The teachers sat amongst their students and actively engaged and modeled attending skills during puppet shows and NEC songs, interjecting science-related questions or activating their students’ background knowledge.

During interviews, the preservice teachers acknowledged the support classroom teachers and teaching assistants afforded them. Ellie stated she could tell which classroom teachers reviewed the science lessons prior to the nature club sessions. She noticed the teacher in her
second group had already primed the students because they came to nature club excited and interested about the science topic. She was appreciative for the support and believed it considerably relieved some of her “anxiety.”

Because the preservice teachers were either leading or simultaneously teaching small groups, minimal opportunities were available for them to observe inservice teachers or others teaching science. However, Brooke commented she made one observation that taught her how to approach and encourage preschoolers with special needs to join science activities. She observed a special education student intern gently encouraging and guiding an apprehensive preschooler with special needs into a small group planting lesson. She commented that while preschoolers with special needs were included in one of her sessions, she was so overwhelmed by “crowd control” that she didn’t have opportunities to observe or interact with them as science learners.

At the same time, other classroom teachers were observed completely surrendering their classes to the preservice teachers (SLO). One preservice teacher described her experience as, “Well, I think the teachers took it as, ‘Okay, this thirty minutes is when these kids [preservice teachers] are in charge and then kind of just stepped back” (Brooke, I2). Although inservice teachers and assistants were observed leading small group activities, they provided little to no classroom management or control over the students. Loud, disruptive behaviors were ignored or poorly addressed and at times led to power struggles between staff and students disrupting the inquiry-based learning activities. The teachers were observed sitting in chairs outside of the student area and showed little interest in the nature club events. An interesting finding was who the preservice teachers perceived as the problem. Following a somewhat hectic NEC session, one preservice teacher viewed the regular preschool teachers as having “ineffective methods of dealing with their students’ behaviors” (Ava, I1) while her co-teaching partner viewed the
preschoolers as the problem, describing them as “wild and awful” (Ellie, I1). In a later interview, this preservice teacher reported she had tried different things, such as using positive and encouraging words to gain their cooperation, but when that didn’t work she didn’t know what to do other than to ignore them and direct her attention to the ones who were attentive – “I just got more comfortable with just ignoring them and that helped me” (Ellie, I2).

Some preservice teachers felt the lack of teacher involvement or enthusiasm adversely affected their science teaching experience because it minimized the science learning potential of the nature club experience,

*So, the actual garden part which is the focus, its’ effect was really pretty minimized. I don’t think the kids really knew they were growing stuff. I don’t think the teachers ever showed them the plants and looked at what was growing in the garden. They didn’t seem to know what was ever growing.* (Ava, I2)

*I think spreading a positive attitude to all teachers, which you can’t really do because it is hard to really control that, but even if they don’t have the attitude, “Yay Nature Explorers,” at least, have them with the attitude ‘I have to at least keep my kids under control.’ It was just so frustrating.* (Ellie, I2)

The second factor most preservice teachers reported as adversely influencing their science teaching experience was how some preservice teachers perceived it lack of involvement of classroom teaching staff. While Ellie (I2) stated her confidence towards teaching science increased each week, the “vibes” she got from some classroom teachers and assistants made her doubt herself, “I never felt like I did anything right in that class.” Ava (I1) expressed she never felt welcome and “like an outsider.” Similar feelings were expressed by other preservice teachers as well:
I think what I was more nervous about is the teachers and like them looking at me and them thinking, “What are you doing?” I always felt like I hope I don’t do anything stupid. Like this is my first time. I’m learning. (Brooke, I2)

It was so intimidating and I felt like I was under constant scrutiny by the teachers like ‘am I doing a good enough job?’ ‘Do I look like an idiot?’ Well, at least I had another person [her partner] so, if we looked like idiots, it was both of us so… (Claire, I2)

After teaching a NEC session, one participant shared she felt as if the teachers viewed her as incompetent and stood there “hardcore judging” her and thinking she was “a loser.” While she enjoyed teaching the nature club and thought she was learning “a lot about what actual teaching is,” she struggled with why some inservice teachers acted so absently.

As an observer, it was unclear as to what role classroom teaching staff was expected to play within the NEC service learning sessions (SLO). You would expect participating PDS teaching staff members to have some awareness of the influence they have over preservice teachers’ learning experiences and therefore, work collaboratively, productively, and encouragingly with them. During my observations, role modeling of science teaching was minimal and available opportunities to observe professional teachers teaching science nonexistent (SLO).

Preschoolers. Some participants reported their confidence towards teaching preschoolers science would have been enhanced if they had been more familiar with the children in the preschool classes. They felt spending only 30 minutes a week with each class compromised their ability to become familiar with the preschoolers’ unique personalities and backgrounds. Claire remarked, “I think getting to know the kids helped me get more confident, but then it [NEC] was over.” Others were of the same opinion:
I feel like it probably would have helped a little bit if we knew the kids better. I had been in a 3 year old class before so I felt kind of competent about the age, but only spending 30 minutes a week with these kids, I never really like ‘knew knew’ them. (Ava, I2)

It would be something fun to do all year though because just when we started getting comfortable with the kids, it was like ‘well, we were done.’ (Brooke, I2)

I think really knowing your kids well, your groups, totally helped with the planning and how they would really learn about whatever it was. (Diane, I2)

Some participants stated the feedback they got from the preschoolers boosted their confidence,

... I [could] hear them singing the nature song and I’m like “I taught you that.” And they [got] excited when they see the plants finally come up and they’re like, ‘I saw plants out on the playground’ and I’m like, “Yeah, you did, you planted them! I taught you that!”

It’s a good feeling like I can do this. (Diane, I1)

I actually have one of the kids in my Nature Explorer’s class in my practicum as well. So, I literally see him every day except for Friday. So, I get to talk to him when I am in my practicum class and he ... is like “Ms. --- we planted seeds.” So, he is like excited about it and it is personal feedback too which is pretty cool. Not just seeing all their reactions but knowing his. (Ellie, I2)

Experiences Alignment with Sources of Self-Efficacy

The remainder of this chapter will focus on answering the second research question, How do the reported influences align with Bandura’s (1997) four sources of information of self-efficacy? To answer question two, teacher statements’ were deductively analyzed and categorized according to their relatedness to the four sources outlined by Bandura (1994).
According to self-efficacy theory (Bandura, 1997), beliefs “are constructed from four principle sources of information” (Bandura, 1997, p. 79): mastery experience; vicarious experience; verbal persuasion; and physiological and affective states. Other sources of self-efficacy in addition to those proposed by Bandura (1997) are also described.

Mastery Experiences. The most influential source of efficacy information described by Bandura (1997) is mastery, which provides authentic evidence of a teacher’s performance in the classroom, with success leading to increased self-efficacy and failure to reduced self-efficacy. Regarding mastery experiences, which for teachers come from actual teaching accomplishments with students (Bandura, 1997), efficacy beliefs are raised if teachers perceive their teaching performance to be a success, which then contributes to the expectations that teaching will be proficient in the future.

Mastery experiences, as proposed by Bandura, were provided within the context of the connected service learning experience, teaching the Nature Explorer Club. One participant perceived all NEC teaching experiences as mastery experiences and three participants perceived approximately half of their NEC teaching experiences as mastery experiences. None of the participants perceived the mastery experiences as the most influential source of efficacy information as proposed by Bandura (1997). Participants perceived NEC teaching experiences as mastery experiences when external factors were optimal to teaching and learning and they successfully engaged the preschoolers in the activities and the preschoolers met the objectives and goals of the lessons. When optimal teaching and learning environments were provided, preservice teachers were observed successfully assessing preschoolers’ prior science-related knowledge, practicing collaborative learning, and differentiating science lessons to engage all preschoolers in the science activities. The fifth participant reported none of the NEC teaching
experiences as mastery experiences because she perceived herself as practicing more classroom management than science teaching.

Not all mastery experiences reported by preservice teachers fit into Bandura’s category because they did not include the actual teaching of children. Firstly, understanding science content knowledge and realizing personal science misconceptions were reported by preservice teachers as enhancing their confidence towards teaching science. Secondly, science pedagogical knowledge was linked to increased confidence of preservice teachers. Participants’ felt having good accurate knowledge of science content and science teaching methods made their teaching experiences more successful.

Vicarious Experiences. According to Bandura, vicarious experiences are one of the main sources that influence the efficacy of teachers and “alter efficacy beliefs through transmission of competencies and comparison with the attainment of others” (Bandura, 1997, p. 79). A vicarious experience is an individual observing another individual teach. When a model with whom the observer closely identifies performs well, the efficacy of the observer is enhanced. In the context of an education program, a vicarious experience is an observation of others teaching or watching a video of a teacher or peer actually teaching real students.

The participants of this study reported vicarious experiences, as proposed by Bandura, positively impacted their self-efficacy towards teaching science. However, vicarious experiences primarily offered within the authentic teaching context of this study were of preservice teachers (as participating observers) watching their co-teaching peer teaching science. While these experiences were reported as beneficial, they believed their science teaching efficacy could have been further enhanced if they had had opportunities to observe experienced teachers or instructors model science lessons, teaching strategies, and class management with actual
preschoolers. Vicarious experiences are an essential part of obtaining self-efficacy and Bandura proposes “competent models transmit knowledge and teach observers effective skills and strategies for managing environmental demands” (Bandura, 1997, p. 88). Instead, simulated modeling, a type of modeling which does not fit neatly into any of Bandura’s (1997) categories of vicarious experiences because it does not involve any observed teaching of real children, was utilized within the course. While preservice teachers reported simulated modeling science lesson plans with instructors and peers as an important efficacy building source, witnessing it under “real-life” conditions would have been more powerful.

Other vicarious experiences reportedly perceived as important towards influencing preservice teachers’ science teaching self-efficacy were aspects of the science-related class – group discussions and reflections. While these experiences are not compatible with those proposed by Bandura (1997), preservice teachers considered them rich science learning experiences. Participants believed these dialogues instrumental in developing their perceived self-efficacy in science teaching. They frequently commented on how in-class discussions helped them better negotiate science teaching in the classroom and afforded them a measure of comfort in better understanding how science is taught to preschoolers. Preservice teachers commented through self-reflection they were able to make more sense out of their science teaching experiences, explore their own self-beliefs towards science and teaching science, self-evaluate, and adjust their thinking and behavior.

*Social Persuasion.* Social persuasion is a third way Bandura proposed as strengthening an individual’s beliefs that they have what it takes to succeed. In other words, social persuasion involves situations in which an individual receives either positive or negative feedback. In this study, all preservice teachers perceived social or verbal persuasion as positively influencing their
self-efficacy towards teaching science. Course instructors, classmates, and preschoolers were reported as sources of verbal persuasion. Course instructors motivated and supported preservice teachers within the course; consistently conveying and validating the confidence they had in the preservice teachers’ overall capabilities to teach science and approach problem solving situations positively. The relationship established between the preservice teachers and their co-teaching partners was one that provided a great deal of verbal support. The persuasive boosts they provided each other promoted self-confidence as well as resiliency. Social persuasion provided by the preschoolers was acknowledged by the preservice teachers as well. The enthusiasm and excitement preschoolers demonstrated during nature club made the preservice teachers feel confident in their ability to successfully teach science. The potency of the social persuasion from the instructors, peers, and preschoolers appeared to alleviate feelings of self-doubt harbored by preservice teachers.

**Physiological and Emotional States.** The fourth and final source of efficacy is the physiological and emotional states such as anxiety, stress, and mood states. As Bandura (1997) stated, “People fear and tend to avoid threatening situations they believe exceed their coping skills, whereas they get involved in activities and behave assuredly when they judge themselves capable of handling situations that would otherwise be intimidating” (p.194).

In this study, preservice teachers reported physiological and emotional states strongly impacted their confidence towards teaching science and negatively impacted mastery experiences. The primary source of anxiety and stress reported by preservice teachers was within the context of the authentic teaching experience, or NEC. Their affective states were mostly influenced by feelings of being inadequately qualified to manage the teaching environment, perceptions of being negatively judged by classroom teaching staff, and/or lack of being
supported by classroom teaching staff. A strategy all preservice teachers used to relieve their feelings of vulnerability was crediting the negative circumstances to the poor performance of classroom teaching staff, not themselves. Other strategies preservice teachers employed to attend to their physiological states included deep breathing, self-pep talks, and thinking rationally. Despite the aversive circumstances, preservice teachers persevered and believed in themselves as novice science teachers.
CHAPTER 5
DISCUSSION AND CONCLUSIONS

Regardless of arguments put forth for teaching science in the early years, research reveals very little science learning occurs in many preschool classrooms (Brenneman, Gelman, Massey, Roth, Nayfield, & Downs, 2007; Greenfield et al., 2009; Tu, 2006). One reason attributed to this situation is preschool teachers’ lack of confidence in their ability to teach science to young children (Appleton, 2008; Garbett, 2003; Sackes, Cabe, Trundle, Bell, & O’Connell, 2011). Therefore, suggestions have been made for more science in birth through kindergarten teacher education programs to enhance science teaching confidence (Harlen & Holroyd, 1997; Spector-Levy, Baruch, & Mevarech, 2011). The first goal of this study was to examine preservice birth through kindergarten teachers’ perceived self-efficacy in teaching science at the preschool level during a semester-long science education course with connected service learning. The second goal was to analyze how these experiences aligned with Bandura’s four sources of self-efficacy. The research questions guiding this study were: (a) How do preservice birth through kindergarten teachers perceive their experiences in a science course with connected service learning influence their self-efficacy towards science teaching, and (b) How do these reported influences align with Bandura’s (1997) four sources of information of self-efficacy? This chapter presents a discussion and conclusions drawn from the findings, implications for practice and future research, and limitations of the study.
Discussion and Conclusions

Birth through kindergarten preservice teachers’ reported experiences within the science-related course and connected service learning included elements of all four sources of self-efficacy as proposed by Bandura (1997). Four participants reported all four sources were salient to some degree in enhancing their self-efficacy. The fifth participant reported her self-efficacy towards teaching science was enhanced through vicarious, social persuasion, and physiological and emotional states but not mastery experiences. In addition to sources proposed by Bandura (1997), self-reflection, simulated modeling, science content and science pedagogical knowledge were also reported as valuable sources for enhancing preservice teachers’ self-efficacy towards teaching science.

Although Bandura asserts that “enactive mastery experiences are the most influential source of efficacy information” (Bandura, 1997, p. 80), this was not the case in this study. While four participants reported all or some authentic teaching experiences as mastery experiences, they did not report them as more influential than the other three sources. This result is consistent with findings of studies conducted by Bautista (2011) and Wagler (2011). In the study by Bautista (2011), the majority of participants reported mastery and vicarious experiences as the most important sources of efficacy and Wagler (2011) found no correlation between preservice elementary teacher’s science teaching efficacy scores and the number of science teaching lessons or mastery experiences. Hence, an assumption may be made that each source and the different combinations and interactions of the sources may influence individuals differently based on context and circumstance.

In this study, one participant deemed all authentic teaching experiences as mastery experiences while three participants deemed approximately 10 authentic teaching experiences as
mastery experiences. When external factors were conducive to teaching and learning (i.e., class sizes were reasonably sized and classroom staff supported them in group management), these successful science teaching experiences led them to believe they could effectively teach science. Under these circumstances, participants were observed confidently transferring course learned skills to an authentic classroom experience – raising questions, exploring materials, and encouraging preschoolers to use their senses to enrich their explorations. They reported these experiences enhanced their confidence towards teaching science and predicted themselves competent enough to use similar science lessons and puppetry in their future classrooms. The fifth participant did not consider any of the authentic teaching experiences as mastery experiences. She reported a lack of classroom management and classroom teacher support hindered her from successfully teaching science to the preschoolers.

Four preservice teachers perceived the efficaciousness of some mastery experiences could have been strengthened if class sizes were manageably sized and classroom teaching staff assisted in managing the unfamiliar preschoolers. Preservice teachers did not perceive themselves as qualified to meet the demands of such circumstances which diminished the impact of some authentic teaching experiences on their self-efficacy towards teaching science. In the aforementioned study by Wagler (2011), making field experiences more rigorous by increasing authentic teaching opportunities did not correlate to an increase in preservice elementary teachers’ science teaching efficacy when adequate support was not provided. While teacher education programs need to afford preservice teachers frequent opportunities for actual experiences with instructing and managing children in a variety of context, the teaching events should move over the course of the semester from less to more frequent, less to more challenging, and from less to more complex (Tschannen-Moran et al., 1998). This was evidenced
in a study by Wingfield, Freeman, and Ramsey (2000). They found a PDS-based preservice education program enhanced science teaching self-efficacy through mastery experiences when preservice elementary student teachers assisted with small group activities with children, then planned and implemented whole class science lessons. Preservice teachers believed if this apprentice-like teacher training approach was used, mastery experiences would have had a stronger influence on their self-efficacy towards teaching science.

Within the context of this study, the role of classroom teachers was perplexing. While they were not assigned the role of cooperating or supervising teacher, one would predict PDS affiliated teachers would have played a more active role in developing and nurturing science teaching efficacy beliefs of the preservice teachers. The cooperating teacher’s professional role has been found to be a considerably important in the teacher education process (Fives et al., 2007; Knoblauch & Hoy, 2008). With respect to interaction between cooperating teachers and student teachers, Fives et al. (2007) found student teachers who experienced higher levels of guidance from their cooperating teacher early in their teaching practicum had significantly higher levels of efficacy for instructional practices at the end of the practicum compared to students who reported less guidance. Knoblauch and Hoy (2008) also showed that an efficacious cooperating teacher was positively correlated with the student teachers’ efficacy beliefs. The student teachers who perceived their cooperating teachers as efficacious were more efficacious themselves.

Participants of this study acknowledged understanding science content and pedagogy as further enhancing their self-efficacy towards teaching science. While understanding science content knowledge and science pedagogical knowledge are not sources of efficacy proposed by Bandura (1997), researchers have found them as sources linked to increased confidence and self-
efficacy of preservice teachers (Appleton, 1995; Palmer, 2006b; Schoon & Boone, 1998; Settlage, 2000). Palmer (2006b) argues content and pedagogical knowledge as “prerequisites for mastery experiences in teaching, as successful teaching experiences partly depend on having good knowledge of content and teaching methods” (p. 349). Participants in this study frequently mentioned how understanding science content not only strengthened their self-efficacy but informed them of misconceptions they unknowingly held. Successful learning experiences involving the understanding of science teaching techniques were also sources of self-efficacy. Preservice teachers stated they entered the course with little to no understanding of how to teach science to young children. Mastering an understanding of developmentally and effective techniques for teaching science to preschoolers made an important contribution towards developing their science teaching self-efficacy. Similar findings were found in a study by Settlage (2000). Elementary teachers who embraced the learning cycle as a viable teaching approach were more efficacious in their ability to shape students’ science learning.

Preservice teachers also reported vicarious experiences strongly influenced their self-efficacy towards teaching science. Within the context of this study, vicarious experiences as proposed by Bandura (1997) primarily occurred when preservice teachers observed fellow classmates demonstrating science teaching. According to Bandura (1997), “the attainments of others who are similar to oneself are judged to be diagnostic of one’s own capabilities” (p. 87). All participating preservice teachers believed witnessing peers teach science within the same situation positively affected their self-efficacy to teach science. However, preservice teachers believed their confidence could have been further enhanced if given opportunities to observe more experienced instructors and inservice teachers demonstrate science teaching with actual preschoolers. Charalambous, Philippou, and Kyriakides (2008) found preservice elementary
teachers’ self-efficacy to teach mathematics was strongly enhanced when they were given frequent opportunities to observe, imitate, and analyze mathematics lessons taught by inservice teachers. Thus, preservice teachers believed their self-efficacy may have been further enhanced if other positive sources of vicarious experiences were offered by teacher educators or inservice teachers modeling science teaching.

Another source of vicarious experience which preservice teachers perceived strongly influenced their self-efficacy towards teaching science was simulated modeling. This type of modeling does not fit into Bandura’s category of vicarious experience because it does not involve any observed teaching of real children. However, the participants in this study stated experiences of directly being shown how to teach children science rather than just being told helped improve their confidence that they could teach science confidently. This was evidenced in a study by Posnanski (2002). He found science teaching efficacy was improved in a course that included a type of modeling in which the instructor assumed the role of a primary teacher and the students assumed the role of children, as they participated in hands-on activities in preparation for real experiences in schools. Rice and Roychoudhury (2003) also argued that this type of modelling as an important component of a science methods course for elementary teaching. Palmer (2006b) cautions while simulated modeling has been shown as a source of efficacy, there is a potential problem with this type of modelling. Because teacher education students are at a vastly different educational level to preschoolers, it should not be assumed that this technique which promotes motivation and learning with adult-aged students will be just as effective with young children. Hence there is the potential that the use of this type of modeling could create false expectations of efficacy. However, this was not observed to be the case in this study.
Instructors made preservice teachers aware of this issue and discussed young children as science learners in conjunction with the simulated experiences.

In-class activities of group discussions, lesson plan reviews, and reflective dialogues were perceived by perservice teachers as valuable and essential vicarious experiences. While these experiences are not included in those proposed by Bandura, Bandura (1986) supports self-reflection as a positive contribution to altering a person’s thinking and actions. Most preservice teachers stated self-reflection as instrumental in helping them examine their own beliefs about teaching and student learning during their authentic teaching experiences. During reflective discussions, preservice teachers were observed practicing self-assessment of their own development as teachers.

In this study, social persuasion emerged as an important source of efficacy for preservice teachers. During the course, relationships established between instructors and peers provided a great deal of verbal support and were positively linked to building self-efficacy of the preservice teachers. Preservice teachers viewed their instructors as credible, trustworthy, and experts on teaching science to preschoolers which made them powerful sources of social persuasion. Another essential source of social persuasion was provided by peers especially co-teaching classmates. Positive socialization and encouragement between preservice teachers was reported as a strong influence on the self-efficacy of the participants. Hoy and Woolfolk (1993) stress that efficacy grows from real success with students rather than only the “moral support or cheerleading of professors and colleagues” (p. 394). In this study, social persuasion frequently counteracted self-doubts preservice teachers formed about their ability to teach science. Consistent persuasive boosts from instructors and classmates encouraged the preservice teachers to persevere and continuously use new strategies and methods leading them to successful science
teaching experiences. In addition, most participants found the enthusiasm and social persuasion provided by preschoolers as a source of positive information thus compelling them to continue teaching science despite obstacles. Hence, social persuasion in the form of excitement and compliments raised teacher candidates’ emotional arousal, which in turn increased feelings of personal competence and mastery (Bandura, 1986, 1997). Although verbal persuasion from efficacious cooperating teachers has been found to develop high levels of self-efficacy (Fives et al., 2007; Knoblauch & Hoy, 2008), it was not a source of social persuasion in this study.

The findings of this study also found physiological and emotional states as strongly influencing participants’ confidence towards teaching science. Preservice teachers reported classroom teachers increased their stress and anxiety levels and significantly decreased their feelings of confidence towards teaching science to preschoolers. They expressed feeling intimidated, judged, and stressed out by classroom staff. To overcome these feelings, preservice teachers utilized anxiety-reducing strategies that allowed them to focus their attention and energy on teaching science to the preschoolers. Interestingly, preservice teachers eventually came to terms with these feelings and interpreted them not as a sign of their own lack of ability or poor performance but, that of adverse teaching conditions and classroom teachers’ poor performance.

**Study Limitations**

Like all studies, this study had limitations. Firstly, not starting this study at the beginning of the course was a primary shortcoming. Participation in the first five weeks of the course may have influenced participants’ perceptions possibly affecting the findings of this study.

Secondly, five preservice teachers comprised this sample. They were not randomly chosen or heterogeneous, but purposively chosen by the researcher for their enrollment in a
science-related course with connected service learning designed for birth through kindergarten preservice teachers. This study’s findings are only generalizable to the participants themselves.

Thirdly, this study did not examine preservice teachers’ self-efficacy towards teaching physical science. Course and service learning experiences concentrated on teaching scientific skills and methods, life science, earth science, and environmental science.

Lastly, this study offers several opportunities for future research in this area. This study does not provide information about how long teacher candidates maintain their increased levels of self-efficacy after completion of the course. The changes in preservice teachers’ self-efficacy towards teaching science in this study might not necessarily indicate permanent changes in self-efficacy. Longitudinal studies should be carried out to investigate the durability of changes on preservice teachers’ self-efficacy towards teaching science as they enter student teaching and their professional careers.

Implications for Practice and Research

Upon completion of the science-related course and connected service learning, the participants reported a positive self-efficacy towards teaching science that was not only supported by their own words, but through observations and course-related artefacts. All but one participant perceived primarily all of the experiences offered through the science-related and connected service learning improved their confidence towards teaching science to preschoolers. This study gives some insight into aspects of experiences birth through kindergarten preservice teachers perceive as positively impacting their self-efficacy towards teaching science and those that could be adjusted.

The connected service learning aspect of the course provided what Bandura (1997) terms mastery experience. In this study, not all participants judged the authentic teaching experiences
as mastery experiences. These participants felt the struggle of taking on the lead teacher role over large groups of unfamiliar, unmanageable preschoolers with little to no support from classroom teaching staff precluded attempts to successfully teach science to the preschoolers, thus diminishing the efficacy-building potential of these teaching experiences. These authentic teaching experiences could have been a more powerful source of self-efficacy if participating classroom teachers and assistants were more knowledgeable of how to provide guidance for effective mentorship and coaching of preservice teachers and if groups of preschoolers were more familiar and manageably sized. In addition, progression of authentic teaching experiences in small supported steps (leading small groups leading to entire classes) would have also enhanced the effectiveness of mastery experiences. Other efficacy sources preservice teachers perceived as enriching the quality of the mastery experiences were content knowledge and pedagogical knowledge.

Vicarious experiences, as proposed by Bandura (1997), were another aspect of the service learning course. As participating observers, preservice teachers observed co-teaching peers model science lessons. While these experiences were deemed beneficial towards increasing their confidence towards teaching science, they expressed observing experienced teachers or their instructors model science teaching with actual preschoolers would have improved the mastery experiences. Simulated modeling was also reported as being an effective efficacy source for preservice teachers. While not a source proposed by Bandura (1997), being shown how to teach children rather than just being told helped improve their confidence. Other in-class group discussions, lesson plan reviews, and reflective dialogues were identified as essential experiences.
Social persuasion was also a strong component identified by preservice teachers as enhancing their efficacy towards teaching science. Course instructors were powerful sources of social persuasion and perceived as sincere, trustworthy, and experts by preservice teachers. Classmates, especially co-teaching classmates, were identified as powerful sources of social persuasion as well. The enthusiasm and excitement of the preschoolers was also identified as a source of positive social persuasion.

Physiological and emotional states were also noted in this study. High levels of stress and anxiety were reported within the context of service learning experiences; however, preservice teachers utilized effective strategies to reduce these levels and persevered building resiliency.

The results of this study are beneficial not only to those involved with this specific course but also for those who design or may consider designing science-related courses for birth through kindergarten preservice teachers. Furthermore, these results shed light upon effective experiences of a science content course and authentic teaching experience. This is becoming more important at the birth through kindergarten level in particular as research has shown foundations for future science learning are laid in the earliest years of a child’s life (NSTA, 2014). Affording birth through kindergarten preservice teachers essential experiences to develop self-efficacy towards teaching science may potentially narrow the gap which seems to exist between national science early learning standards and the absence of science teaching in preschool and prekindergarten classrooms.

This research is important as a tool to inform stakeholders such as teachers, teacher educators, and policymakers. For teachers, it is important to note that their own efficacy, their belief in their abilities to teach science, is an important component in how they approach and teach science to young children. They should be mindful of how “insidious self-doubts can easily
overrule the best of skills (Bandura, 1997, p. 35). This is also important for teacher educators. As they design courses, they need to consider not only the science content and pedagogical knowledge they wish to convey but also how to develop reflective practices and provide experiences aligned with Bandura’s four sources of self-efficacy. Improving science learning should be of concern to education leaders because early experiences affect later education outcomes. Providing young children with research-based science learning experiences affords them vital opportunities to become science-ready kindergarteners, science-achieving K-12 achievers, and science-literate citizens.

For future research, I would like to design a study to address some of the temporal limitations of this study. Most notably, I would begin the study prior to the science-related course’s commencement and conduct a longitudinal study following a group of prospective birth through kindergarten teachers as they progressed through their teacher education program, particularly the science-related course and connected service learning experience, and revisit these participants again in the early years of their careers to collect information about how the efficacy changes towards teaching science may have persisted or eroded after completion of the course. Durability is an important consideration in Bandura’s (1997) social cognitive theory. Hence, a future study focusing on how well the changes are maintained over time could investigate to what extent positive changes in self-efficacy are maintained over time after the completion of a science-related course with connected authentic teaching experiences.

Another avenue for future research in this area is investigating other sources of self-efficacy in addition to those proposed by Bandura (1997). Cognitive content mastery (successes in understanding science content), cognitive pedagogical mastery (successes in understanding how to teach science) and simulated modelling (in which teaching is role played) have also been
argued to be sources of self-efficacy (Palmer, 2006a). For example, what is the relative importance of each of these in comparison to the other sources and to what extent can these sources enhance the self-efficacy towards teaching science of birth through kindergarten teachers? Research that can provide answers to these types of questions may potentially play an important role in the design of future preparatory courses for birth through kindergarten teacher education students.
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APPENDIX A: IRB APPROVAL OF PROTOCOL

February 4, 2015

Dear Cynthia Vail:

On 2/4/2015, the IRB reviewed the following submission:

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The IRB approved the protocol from 2/4/2015.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRI-100).

Sincerely,

Larry Nackerud, Ph.D.
University of Georgia
Institutional Review Board Chairperson
APPENDIX B: INTERVIEW GUIDE

Introduction (Interview 1)

I am curious about how you got interested in birth to K education. Can you tell me what led you to this program?

Background (Interview 1)

Tell me more about your experiences as a science learner in elementary through high school and college. Possible probes “tell me more about that/or this teacher …,” “can you tell me about any specific memories you have about …,” “can you give me an example …”

Course Experiences

1. Tell me about your first impression of the Nature Explore Club course.

2. Describe how the following in-class experiences have influenced your confidence towards preparing and teaching science in your NEC sessions.
   a. Group discussions (how comfortable are you sharing about your experiences –those that have gone well or not so well, how does listening to your peers’ experiences influence your confidence?, how helpful is the feedback from instructors as well as peers towards building your confidence?)
   b. Reflections (during class, how comfortable are you sharing your reflections about your NEC and sharing them with instructors and peers? How helpful is it to hear others reflections?)
   c. Lesson Planning (What is your overall comfort level in planning lessons thus far in your program (give scale 1-5 if needed)? How helpful are the instructor created lesson plans? How has having a partner to collaborate with )
   d. Modeling (how helpful is to observe your instructors model the puppet shows and lessons? What about observing your peers?)
   e. Relations instructors and peers (comfort level in discussing successes and possible failures with instructors and amongst peers)
   f. Do you feel any one area over the other affects your confidence or capability to teach science more than another?
**Service-learning related questions**

a. Tell me about your partner and how you are collaborating.

b. During NEC, you and your partner are actually acting as the teachers and leading the lesson. Describe how you felt (nervous, anxious, prepared,….) before and after. Probe why they had such feelings.

c. Tell me about the NEC classes you’ve been assigned to teach.

d. Tell me about your first nature explorer club session? What was the lesson plan topic? What do you think you did well? Probe reasons for success and if contribute to class experience. What do you think could have gone better? Probe for reasons why it didn’t go so well.

e. Tell me about how the children have responded to your NEC. How does their reaction make you feel? Can you share anything they may have had said or done?

f. So tell me when you reflected back on the lesson, what did you feel confident doing? Why? What did you feel less confident or less comfortable doing? Why?

2. Is there anything else about the experience that you would like to tell me about or that you feel like I haven’t asked you about?

**Interview 2 Guide**

The following questions are about your total experience in the course which included the class sessions and the NEC sessions.

1. Identify and describe which experiences in the course and service learning you perceive have increased your confidence and ability towards teaching science. (Probe for specifics and/or examples about the description of the experiences.)

   or

   If you don’t feel any more or less confident to teach science than when the course started, describe your overall experience and explain why they may not have had an impact on your confidence.

2. Think back for a minute to your first NEC session and think of your last NEC session (final garden party). Describe yourself as a “science teacher” now? (probe for “I can…, I feel ….”).

3. How do you think this course and service learning experience will influence your confidence in your future teaching science practice?
4. What was your overall impression of the course and service leaning experiences as they relate to your confidence to teach science?