NOVICE ELEMENTARY TEACHERS' SELF-EFFICACY FOR TEACHING SCIENCE:

A PHENOMENOLOGICAL STUDY

by

Graquetta Banks Harris

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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APPROVED BY:

Dr. Kenneth Tierce, Committee Chair

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ABSTRACT

The purpose of this transcendental phenomenological study was to understand perceptions of self-efficacy in science pedagogical content knowledge (PCK) for novice elementary school teachers at various elementary schools in central Georgia. Novice elementary school teachers were those traditionally prepared, and self-efficacy was the confidence in science PCK for elementary school teachers. The two theories guiding this study included Bandura's self-efficacy theory and Shulman's theory of PCK, as they supported the process of self-efficacy and PCK of novice elementary school teachers. The participants included 15–20 elementary school teachers who completed a traditional teacher preparation program and had fewer than 5 years of teaching experience. The setting was various elementary schools in central Georgia. Data collection followed qualitative procedures and included individual interviews, surveys utilizing the Science Teaching Efficacy Belief Instrument, and a focus group interview. Data analysis included interview transcription, data coding, horizonalization, reduction and elimination, clustering and thematizing, and construction of textural descriptions to give an overview of the teachers' perceptions. The research resulted in an understanding of the experiences of novice elementary teachers while teaching science content. The findings of this research revealed varied experiences of novice elementary teachers and self-efficacy related to science PCK. Although participants in this study expressed their love of the teaching profession, most of them expressed negative emotions when confronted with teaching science at the elementary level. This negatively impacted their self-efficacy. Further research should focus on a different demographics (gender, race, age) and veteran educators who still may struggle with self-efficacy.

Keywords: novice elementary school teachers, pedagogical content knowledge or PCK, self-efficacy

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Dedication

I would like to dedicate this work to my father, Grady Edward Banks (August 31, 1950 – February 23, 1991), who never accepted anything less than my best and to my sister, Grashunda Enise Banks (April 19, 1978 – July 23, 2000), who would have been an excellent educator.

Acknowledgments

First, I want to thank my mother, Olivia Hightower Banks, for always supporting me regardless of the path I chose to follow. She has been the calm voice of reason, the stern voice of correction, and the uplifting voice of encouragement. I am forever grateful that God chose her to be my mother. Second, I want to thank my husband, Kelsey Jerell Harris, for being by side since we were teenagers in high school through all of life so far. He has shown me nothing but love spoken of in 1 Corinthians 13:5-8. Next, I would like to thank my daughter, Kelyse Grashunda Harris, who had to do many things without me because I was writing or researching. I appreciate her patience and understanding. I pray that she realizes that everything I do is for her. I would also like to thank my siblings, Gratasha and Jarvis, for keeping me grounded during this journey. I appreciate my extended family and friends who have been my cheerleaders throughout this journey. Finally, I would like to thank my committee chair, Dr. Randy Tierce, and my committee members, Dr. Vonda Beavers and Dr. Brandee Murrah, for the reviews, comments, and suggestions given to me along with encouragement and support. It is only by the grace of God that I am at this point and I am grateful for his grace and mercy that have brought me this far. I give all praise and thanks to Him.

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List of Abbreviations

American Association for the Advancement of Science (AAAS)

Canon County Elementary School (CCES)

Engage, investigate, model, apply (EIMA)

Every Student Succeeds Act (ESSA)

Institutional Review Board (IRB)

Laughlin County Elementary School (LCES)

Moore County Elementary School (MCES)

National Assessment of Educational Progress (NAEP)

National Center for Education Statistics (NCES)

National Research Council (NRC)

National Science Education Standards (NSES)

National Science Teachers Association (NSTA)

Nature of science (NOS)

Next Generation Science Standards (NGSS)

No Child Left Behind Act (NCLB)

Organization for Economic Cooperation and Development (OECD)

Pedagogical content knowledge (PCK)

Personal Science Teaching Efficacy (PSTE)

Porter County Elementary School (PCES)

Sander County Elementary School (SCES)

Science Teaching Efficacy Belief Instrument (STEBI)

Science Teaching Outcome Expectancy (STOE)

Science, technology, engineering, and math (STEM)

Teacher Efficacy Survey (TES)

Teacher Sense of Efficacy Scale (TSES)

Unity County Elementary School (UCES)

CHAPTER ONE: INTRODUCTION

Overview

Science is a complex subject to master (Nilsson & Loughran, 2012). To reach full mastery, meaningful learning experiences must begin at the elementary level (Van Driel & Berry, 2012). Because of its complexity, science situates educators into difficult positions to effectively teach the subject matter (Arias, Bismack, Davis, & Palincsar, 2015). To effectively teach the science content, teachers must not only comprehend the topics for themselves, but also have the confidence to successfully instruct the students (Duschl & Grandy, 2013). Many new elementary science teachers do not have the confidence in their content knowledge to teach the science content they are tasked with on the elementary level (Duschl & Grandy, 2013). The lack of confidence in science content knowledge exists because teacher candidates receive very little instruction for science in traditional teacher preparation programs (Lederman & Gess-Newsome, 2010; Veal, van Driel, J. & Hulshof, 2011). According to Duschl and Grandy (2013), there are certain levels of content knowledge that must attained for teachers to be competent in teaching science. Further literature describes the amount of pedagogical content knowledge (PCK) necessary for successful science teaching (Loughran, Berry, & Mulhall, 2012; Nilsson & Loughran, 2012; Van Driel & Berry, 2012). Consequently, novice teachers who lack the minimal amount of PCK do not have the self-reliance to teach the subject matter. Because of the lack of PCK, teachers with less than 5 years of teaching experience are often intimidated by student questions and have difficulty expounding upon the topics that are a part of the grade level science curriculum (Nilsson & Loughran, 2012).

Chapter One includes a brief description of the background of the study, the formal problem and purpose statements, an explanation of my role as the researcher, the significance of the study, research questions, and a list of key definitions for terms used in the study.

Background

Historical Context

Since the passing of the 2001 No Child Left Behind Act (NCLB) and continuing with the implementation of the 2015 Every Student Succeeds Act (ESSA), schools around the nation have been focusing attention on standards-based curriculum and the requirements of highly qualified teachers in each grade level and subject matter (National Science Teachers Association [NSTA], 2011). Both the NCLB and the ESSA require that teachers know the content matter they teach. The presence of a highly qualified teacher in each classroom is one of the most important requirements under both the NCLB and ESSA. According to the U.S. Department of Education (2014), teachers must have a minimum of a bachelor's degree, passing scores on state-approved assessments and full state certification to be considered highly qualified. The requirements for teachers to be classified as highly qualified remained the same throughout the duration of the NCLB and continue with the ESSA. However, the level of student achievement on state-mandated assessments has increased significantly and continues to increase yearly.

Policymakers, higher-learning institutions, and licensing boards have debated the amount of content knowledge that highly qualifies teachers (Lederman & Gess-Newsome, 2010; Veal et al., 2011). Elementary school teachers are only required to know small amounts of science content to complete the degree requirements of elementary education majors. In many teacher preparatory programs, few science courses are required for elementary certification that meets the standard to be considered highly qualified by criteria set forth by the federal NCLB legislation (Goe & Stickler, 2008). Goe and Stickler (2008) focused their examination of teacher quality on four categories of indicators including teacher practice, teacher effectiveness, teacher characteristics, and most importantly, teacher qualifications. Teacher qualifications include credentials, content knowledge, and content experiences (Goe & Stickler, 2008).

Social Context

Lack of science understanding among students has been identified as one of the primary factors contributing to increased disinterest in science related careers (Clermont, 2014). In response to the decline in science interest, two leading science education organizations, American Association for the Advancement of Science (AAAS) and National Research Council (NRC) have called for an increase in science literacy among students. The science literacy visions of the AAAS (1998) and NRC (1996) promote reducing the current overabundance of topics in the curriculum and instead leaning towards emphasizing the understanding of ideas essential to science literacy. In order to streamline the curriculum, teachers must have a strong grasp of the science content for the purpose of expounding the topics to get beyond simplistic vocabulary and memorization (Goe & Stickler, 2008). According to the NRC's (1996) National Science Education Standards, being scientifically literate implies that one is able to ask questions that have been derived from curiosity in regard to everyday experiences, appraise the value of scientific information as well as present, and evaluate arguments based on evidence. Scientific literacy is often used interchangeably with the science literacy.

Theoretical Context

Science has not been explored to the same extent as literacy and math in regard to the amount of time and effort devoted to improvement (Goe & Stickler, 2008). Goe and Stickler (2008) suggest that the research should continue to explore teacher content knowledge in other content areas. The long-term impact of teacher self-efficacy and PCK has not been adequately explored with significant research (Lederman & Gess-Newsome, 2010). The focus of previous research has been focused on secondary school educators and their self-efficacy in relation to their PCK (Albion & Spence, 2013; Avery & Meyer, 2012; Bursal, 2012; Sandholtz & Ringstaff, 2014; Shroyer, Riggs, & Enochs, 2014; Skaalvik & Skaalvik, 2014; Wang, Tsai, & Wei, 2015). For instance, several studies have revealed that teacher completion of undergraduate or graduate majors in science is associated with higher teacher self-efficacy in high school and middle school science teaching (Appleton, 2013; Hagevik, Jordan, & Wimert, 2015; Ma, Lo, & Chan, 2012; Veal et al., 2011). Although there are many quantitative studies regarding teacher efficiency in science teaching, there is a gap in the literature related to the voices of novice elementary teachers regarding their efficacy (Cakiroglu, Capa-Aydin, & Hoy, 2012; German, 2014; Klassen & Durksen, 2014; Sharma, Loreman & Forlin, 2012).

There is little literature related to novice elementary science teachers and their level of confidence for teaching science. Elementary grades are crucial in the progression to science mastery. For the purpose of this study, elementary was defined as Grades 3 through 5. According to research, the elementary level is critical to subsequent academic achievement in science (Rice & Kaya, 2012). It is at this point that students are beginning to lay the foundation for their future learning experiences in science (Rice & Kaya, 2012). Because of the importance of these years as an integral part of the future development in science content, a better comprehension of how novice teachers gauge their confidence in teaching science is essential to better prepare these elementary teachers to teach science at the elementary level.

Situation to Self

In this study, I explored novice elementary science teachers' sense of efficacy for teaching science (Moustakas, 1994; van Manen, 1990). I have a constructivist view of teaching and learning as I believe that learning has more meaning when learners construct their own understanding about the content through experiences and reflection. While considering the research, I brought the paradigm of constructivism to guide the research, as I allowed the participants to construct the meaning of how they view their efficacy for teaching science at the elementary level (Piaget, 1967).

Building on Piaget's (1967) theories of assimilation and accommodation, I learned how the novice science teachers in this study assimilate or accommodate new theories of teaching science into their existing experiences as elementary teachers. An axiological assumption reflected my belief that the study participants are children of God who were created for a purpose and are fearfully and wonderfully made by the Lord. This belief system guided the way I interacted with the participants to ensure they felt valued and respected as they shared their experiences of the phenomenon. My constructivist view, along with my axiological philosophical assumption, shaped the design of this research. Creswell (2013a) noted that researchers with an axiological philosophical assumption express and describe their ideals and predispositions as well as the rich nature of the gathered data. I identify most with the axiological philosophical assumption, which has framed my motivation to conduct this study, to better understand the experience of novice elementary teachers when teaching science content. By taking on the role of the human instrument to interpret the data, I listened carefully to the participants' experiences and allowed their voices to resonate through the study (Moustakas, 1994; van Manen, 1990). The knowledge gained from this study will be the impetus to revise preservice preparation programs to better prepare elementary teachers to teach science content. As a secondary science teacher, I am directly impacted by the quality of science instruction provided to students at the elementary level. Sadly, I have many students who do not have the foundation necessary to anchor new knowledge in advanced science classes.

Problem Statement

According to the 2010 National Science Foundation's Commission on Pre-College Education in Mathematics, Science, and Technology assessment in the Science and Engineering Indicators 2010 (Lehming, et. al), students in the United States performed in the lowest 10% on international standardized assessments when compared to their international peers. The study was conducted by the National Science Board (2010) and during their senior year of high school, assessed the most advanced students in each country that is a part of the Organization for Economic Cooperation and Development (OECD). In an additional study, the National Commission on Mathematics and Science Teaching for the 21st Century (2011) assessed students entering high school on their math and science knowledge. When compared to students from countries of the OECD, the American students were again at or near the bottom in performance. The United States ranked 20th of 35 OECD countries with scores well below the average (U.S. Department of Education, 2011). In another study conducted in 2011 by Snyder and Dillow (2012) of the National Center for Education Statistics (NCES) found that 24.4 % of American 15-year-old students did not meet the baseline level of science achievement, which is a score of 170 or better on the National Assessment of Educational Progress (NAEP) assessment (U.S. Department of Education, 2011). The proficient-level score of 170 is established and important because it represents the level at which competency is necessary to apply science and technology in real-life situations. In the United States, foreign students are completing college degree programs in science, technology, engineering, and math (STEM). When compared to 19 other countries, the United States ranked 15th. When ranked according to science literacy with 35 other industrialized countries, the United States ranked 20th out of 35 countries, scoring below the OECD average of 501 with a 497 (NCES, 2011). There is a lack of meaningful and comprehensive science instruction at the elementary level because teachers are not confident to teach the science content matter (Lindsey, Shroyer, Pashler, & Mozer, 2014; J. C. Marshall & Alston, 2015, NSTA, 2011). Even with this steady decline, the employment opportunities in the areas of science and engineering are growing rapidly (Lehming, et. al, 2010).

Few studies have been conducted to discover the root cause of the underperformance of American students. The major argument that arises from these studies is that the low level of student achievement (less than 170 on the NAEP assessment) is due to teachers who lack self-efficacy for teaching science and are not equipped to teach science at the level that students need to reach proficiency (Cakiroglu et al., 2012; German, 2014; Klassen & Durksen, 2014; Sharma et al., 2012). Teacher self-efficacy is a critical component to successful classrooms and is a significant characteristic associated with instructional quality and student achievement (Guo, Connor, Yang, Roehrig, & Morrison, 2012; Tucker et al., 2005). Consequently, it is one of the most studied aspects of the classroom context. Teacher self-efficacy has been shown to positively affect teachers' beliefs about teaching (Cho & Shim, 2013; Skaalvik & Skaalvik, 2014; Tschannen-Moran & Woolfolk-Hoy, 1998), thereby influencing the classroom instruction and ultimately affecting student outcomes (Zee & Koomen, 2016). Although several of these studies are quantitative studies focused on teacher efficacy in science teaching, there remains a gap in the literature related to the voices of the teachers regarding their efficacy.

This study was aimed to understand the lived experiences of novice elementary science teachers and their confidence when teaching science content. Therefore, the problem of this study was novice elementary school teachers' perceptions of self-efficacy in teaching science content knowledge at five elementary schools in central Georgia.

Purpose Statement

The purpose of this phenomenological study was to understand the perceptions of self-efficacy in science PCK for novice elementary school teachers at five elementary schools in central Georgia. The participants in this study were purposefully selected based on the following criteria: fewer than 5 years of teaching experience, completion of a traditional teacher preparation program, not enrolled in or have completed science content based graduate courses, and teaching at the elementary level in elementary Grades 3–5. Novice elementary school teachers were defined as teachers who were traditionally prepared and who have fewer than 5 years of experience teaching in Grades 3–5. Self-efficacy is generally defined as assuredness in teaching science PCK. The theory guiding this study was the self-efficacy theory (Bandura, 1986, 1997) and the theory of PCK (Shulman, L., 1986) as they support the process of self-efficacy and PCK of novice elementary school teachers as they progress to veteran teachers.

Significance of the Study

It is important to address the root causes of lower student achievement. Lower student achievement is an issue throughout the United States (Crum, Sherman, & Myran, 2010). Stakeholders, including teachers, parents, administrators, and community members are all impacted when students do not perform well academically (Crum, et al., 2010). Many studies look to other areas of investigation as it relates to student achievement, but this study helped fill the gap in literature regarding the teaching of elementary science and teacher efficacy in science PCK. Learning at the elementary level lays the foundation for all future learning experiences (Arias et al., 2015; Kim, Ko, Han, & Hong, 2014). It is at this level that significant learning experiences in science begin (Kim et al., 2014). By expanding the current literature, this study will help advance and improve science teaching at the elementary level.

Exploring novice elementary teachers' perceptions of self-efficacy while teaching science was significant in several ways. First, with the low proficiency rate for student science scores nationwide, teacher preparation programs should ensure that science teaching methodologies are the most effective research-based techniques so that the teacher preparation program enhances the effective teaching strategies of novice elementary teachers (Appleton, 2013; Fleer, 2012; McLaughlin & Barton, 2013).

Additionally, understanding the experiences of novice elementary teachers could better prepare school level personnel to coach and mentor the novice teachers as they develop their own science lessons and work with students to become proficient science students (Lambert, Lindgren, & Bleicher, 2012; Lumpe, Czerniak, Haney, & Beltyukova, 2012; van Aalderen-Smeets, Walma van der Molen, & Asma, 2012). Exploring the phenomenon of the self-efficacy of novice elementary teachers is important to better understand how to prepare teachers so they can model effective methodologies and philosophies for teaching science at the elementary level (Avraamidou, 2014; Beyer & Davis, 2012; Kittleson & Tippins, 2012; Wilson, 2013). The information gained from this study will be beneficial in the design of professional development opportunities to increase the amount of PCK the novice teachers have. Lastly, this study added to the empirical research for science self-efficacy and teaching science self-efficacy by exploring the shared experiences of novice elementary teachers.

Research Questions

The following three research questions were used to guide this study.

Research Question 1

> How do novice elementary school teachers of Grades 3–5 in Laughlin County Elementary, Moore County Elementary, Porter County Elementary, Sander County Elementary, and Unity County schools perceive their self-efficacy in teaching science?

Cakiroglu et al. (2012), Klassen and Durksen (2014), Sharma et al. (2012), and German (2014) have explored various teaching levels, experience, grades, and demographics in relation to teacher efficacy in numerous content areas. Veteran teachers have been studied and preservice teachers' voices have been heard. However, missing from the literature is the voice of the novice elementary educator who teaches science.

Research Question 2

> How do novice elementary teachers in Georgia perceive their self-efficacy in science content knowledge?

According to Bandura (1997) and Lohman (2006), self-efficacy in teaching science content knowledge is important because teachers with high levels of self-efficacy are thought to not only work harder, but also to be more persistent and experience less stress. Self-efficacy can also be a predictor of teacher performance (Ross, 2013). For example, several studies have found a positive relationship between the self-efficacy of teachers and their performance (Cakiroglu et al., 2012; Goddard, Goddard, Kim, & Miller, 2015; Ross, 2013).

Research Question 3

> How do novice elementary teachers in Georgia perceive their preparedness for teaching science after completing a pre-service teacher preparation program?

Cakiroglu et al. (2012) and Shroyer et al. (2014) have explored preservice middle and secondary teachers' perceptions of their teacher preparation program and the level of confidence that the participants felt for teaching science. Cook and Odom (2013) and Savolainen, Engelbrecht, Nel, and Malinen (2012) studied special education preservice teachers' experiences. However, the experiences and the voices of the novice elementary teachers are missing from the current literature.

Definitions

1. *Novice Teachers*–Novice teachers are elementary school teachers with fewer than 4 years of classroom teaching experience (Feiman-Nemser, 2001).
2. *Pedagogical Content Knowledge (PCK)*–Pedagogical content knowledge (PCK) is the term used to describe teachers' interpretations and transformations of subject-matter knowledge in the context of facilitating student learning (L. Shulman, 1986, L.S. Shulman, 1987).
3. *Personal Science Teaching Efficacy*–Personal science teaching efficacy is the term used to describe a Science Teaching Efficacy Belief Instrument (STEBI-A) subscale that addresses how teachers feel about answering student questions, explaining experiments, and monitoring student learning progression (Riggs & Enochs, 1989).
4. *Professional Development*–Professional development is the term used to define in-service training implemented to increase or upgrade the content knowledge or pedagogical skills of teachers with the purpose of improving teaching and learning (Quint, 2011).
5. *Science Teaching Efficacy Belief Instrument (STEBI-A)*–Science Teaching Efficacy Belief Instrument (STEBI-A) is the research instrument utilized to measure science teaching self-efficacy and outcome efficacy for in-service educators (Riggs & Enochs, 1989).

6. *Science Teaching Outcome Expectancy*–Science teaching outcome expectancy is the term used to define a STEBI-A subscale that addresses how teachers refer to expected outcomes in science teaching (Riggs & Enochs, 1989).
7. *Self-efficacy*–Self-efficacy is one's confidence or belief their ability to be successful in a specific context (Bandura, 1986, 1997).
8. *Team-Teaching Model*–Team teaching is a departmentalized model used at the elementary level that involves a pair or trio of teachers who focus on specific content areas (Lambert, 1960).

Summary

The purpose of this phenomenological study was to understand the perceptions of self-efficacy in science PCK for novice elementary school teachers at five elementary schools in central Georgia. This qualitative transcendental phenomenological study was framed by the work of Moustakas (1994) and van Manen (1990).

CHAPTER TWO: LITERATURE REVIEW

Overview

Chapter Two of the transcendental phenomenological study introduces the theories that served as frameworks for the study and a review of related literature on novice elementary school teachers' self-efficacy regarding pedagogical science content knowledge. The literature regarding the theoretical framework theories, Bandura's (1977, 198, 1997) theory of self-efficacy and Shulman's (1986, 1987, 1999) theory of PCK, is reviewed and related literature pertaining to teacher preparation programs, classroom practice, and the nature of science are extensively explored.

Theoretical Framework

The two theories that framed this study were Bandura's (1986, 1987, 1999) theory of self-efficacy and Shulman's (1986, 1987, 1999) theory of PCK. By exploring Bandura's self-efficacy theory, how novice elementary teachers in extant literature describe their confidence in teaching science, is understood (Bandura, 1977, 1978, 1997; van Manen, 1990). In addition to the self-efficacy theory, Shulman's theory of pedagogical content helps guides the research (Shulman, 1986, 1987, 1999).

Theory of Self-Efficacy

Bandura's (1986, 1987, 1999) concept of social learning theory supports how teachers learn to teach subject matter that is not well known through the social environment. The social learning theory suggests a framework for constructing the theory of self-efficacy. In the process of learning in social environments, people experience things through others (Bandura, 1986, 1997). As others share their experiences, novice teachers can pick up tips and learn from those around them. This vicarious learning experience can give novice teachers the ability to gain self-efficacy for specific content concepts (Bandura, 1986, 1997). The process of experiencing learning vicariously helps novice teachers grow by seeing the experiences of others. The vicarious learning experiences prevent much of the self-trial and error and probable snares in the process. Each teacher holds a perception of self-efficacy that is individually unique (Bandura, 1986, 1997). Bandura's (1986, 1987, 1999) theory holds that the confidence level of teachers is a perceived component of the confidence of their achievement.

As the difficulty of tasks increases, novice teachers are in danger of having lower self-efficacy in which they can confidently achieve (Bandura, 1986, 1997). There are many ways to counteract lower self-efficacy (Bandura, 1997). Novice teachers are able to overcome the insecurity they may encounter through mastery experiences, verbal persuasion, vicarious experiences, physiological states, and affective states (Bandura, 1997). Mastery experiences increase self-efficacy as confidence increases as success is attained. Verbal persuasion increases self-efficacy by the utilization of language to improve confidence in attempting new tasks. Vicarious experiences allow the novice teacher to experience a task by watching others. Mastery experiences, verbal persuasion, and vicarious learning experiences give the novice teachers a reference frame for their own new experiences and the confidence to attempt new tasks.

Self-efficacy has many aspects as a concept: It is the internal confidence that the novice teachers possess (Bandura, 1997). This internal confidence varies based upon the undertaking (Bandura & Locke, 2003). Bandura (1997) held that the greater the self-efficacy a person possesses, the higher the effort will be to achieve success. Therefore, if students experience a high level of achievement in a subject, they will continue to work through difficult problems if they do not experience immediate success. The same would be true for teachers. If they have confidence for teaching a subject matter, they will be able to give appropriate instruction to increase student mastery. The use of appropriate instruction makes the way for the experience of mastery (Bandura, 1986). Success breeds increased self-efficacy and increased self-efficacy breeds perseverance in the face of new or difficult tasks (Bandura & Locke, 2003).

Self-efficacy is defined as the belief or confidence that one can be successful when attempting a task (Bandura, 1986, 1997). In the case of teacher self-efficacy, teachers' self-efficacy varies from one content area to another. Teachers can have high self-efficacy in one content area, and yet have low self-efficacy in another. Self-efficacy levels of teachers in content areas vary according to the content, level, and topic.

Affective and physiological states have the potential to affect the body's response to a challenge (Bandura, 1986, 1997). Bandura's (2004) investigation focused on individuals who had suffered heart attacks and how they overcame fears surrounding physical exertion. Bandura (2004) found that the behaviors of his test subjects were closely related to their prior experiences of having heart attacks.

Self-efficacy is not developed in a singular situation. Bandura's (1986) theory holds that humans will develop an expectation of results that is grounded in their past experiences. According to Betz and Hackett (2006), it is an appraisal of one's future performance in their chosen field based upon past interactions and experiences. Ease in accomplishing a task and mastering a skill leads to higher self-efficacy when attempting similar tasks. The human brain consolidates prior experiences to either increase or decrease self-efficacy. Mastering a task fosters an increase in self-efficacy, while not succeeding at a task causes a decrease in self-efficacy (Bandura & Locke, 2003). Mastery allows for the visualization of success and task completion (Bandura, 1993). As stated by Bandura (1993), "People who regard themselves as highly efficacious ascribe their failures to insufficient effort; those who regard themselves as inefficacious attribute their failures to low ability" (p. 128). In the aspect of novice elementary teachers, those with high levels of self-efficacy believe that they can experience success if they increase their work effort. These novice teachers are the ones who will continue to work to achieve a goal even if they do not experience success the first time.

The belief that success can be attained through greater effort is a direct result of increased self-efficacy (Bandura & Locke, 2003). The confidence in the teachers' ability to teach science would result in a greater effort to ensuring student success (Bandura, 1993). Using this theory, low self-efficacy would have the opposite effect. Novice teachers with low self-efficacy may employ less effort in achieving success as they feel that their efforts are pointless.

Self-efficacy is internalized, and the individual thought process used to construct confidence for accomplishing new tasks is based upon reflection of previous experiences. The human mind does not employ the exact same cognitive pathway when there is a new task at hand (Bandura & Locke, 2003). Individuals create their own self-efficacy based on their individual experiences and that creation of self-efficacy could be different for each situation. The amount of effort and work required to achieve success would, according to Bandura and Locke (2003), create a feeling of overwhelming pressure and stress and lead to lower goal setting for the future. Using this theory, novice elementary teachers may experience difficulties and the increased effort and work it requires may lead to a decrease in the amount of effort exerted in the future.

Klassen and Durksen (2014) explored teacher self-efficacy based on Bandura's (1986) theory of self-efficacy, using research that was conducted from 1998–2009. In the beginning, the agreement was that self-efficacy would become a well-developed theory and the new results would give important insights into how teacher self-efficacy plays a role in the school setting. Klassen and Durksen (2014) found that the research was lacking, and a significant amount of necessary information was undiscovered. It was the recommendation of Klassen and Durksen (2014) that more qualitative and longitudinal research be conducted to provide a clearer picture of teacher self-efficacy. Since the beginning of teacher self-efficacy studies, a few domains have been studied, but elementary science teacher self-efficacy has not been researched (Klassen & Durksen., 2014). More research is necessary to explore the domain specific to elementary science education. In addition to domain specific research, qualitative research methods should be employed to have a more complete representation of teacher self-efficacy.

It is essential for novice elementary teachers to keep track of their self-efficacy for teaching science in addition to being aware of how their self-efficacy for teaching science is conveyed to their pupils (Fine, Zygouris-Coe, Senokossoff, & Fang, 2013; Holzberger, Phillip, & Kunter, 2013). Mojavezi and Tamiz (2012) explored the impact of teacher self-efficacy on student motivation and achievement and found that teacher self-efficacy has a positive influence on students' motivation and achievement. The study was an exploration into how the teachers' level of self-efficacy impacted students' reactions in the form of motivation and achievement (Mojavezi & Tamiz, 2012). The finding of this positive relationship shows that the teachers' level of self-efficacy has a direct impact on the students. In a related study, Marsh and Seaton (2013) hypothesized that teachers with low self-efficacy would be less likely to engage in academic interventions with their students because of their lack of confidence that they could impart effective interventions for their students. Hence, studying novice elementary teacher self-efficacy for teaching science is crucial to better understand the role of teachers as a segment of the issues for student achievement in science.

Self-efficacy is essential within the teaching population and is vitally important. Teachers who have low self-efficacy in their abilities to adequately teach content, especially those within the science content area, have been found to be less likely to tackle topics that pertain to the content (Ramey-Gassert & Shroyer, 1992). Tschannen-Moran and Hoy (2001) explained that a teacher's self-efficacy is directly related to how the students perform and ultimately impacts the self-efficacy of the students. Those teachers who have a greater sense of self-efficacy are better at lesson planning, more ambitious when it comes to future plans in the educational field, and willing to take educational risks when it comes to adventuring into new methods to help their students perform better (Tschannen-Moran & Hoy, 2001).

The impact of self-efficacy on the levels of acquisition of content has been widely discussed throughout the literature. Ramey-Gassert, Shroyer, and Staver (1996) explored the importance of self-efficacy while teaching science. Using a qualitative approach, Ramey-Gassert et al. applied Bandura's theory of self-efficacy to connect the beliefs that teachers hold in their abilities to the outcomes that result from their teaching. Their personal belief was referred to as Personal Science Teaching Efficacy (PSTE) and the results were referred to as the Science Teaching Outcome Expectancy (STOE). The teacher efficacy component (PSTE) provides insight into how teacher confidence and teaching ability are connected while the outcome expectancy (STOE) predicts the level of success students will experience when learning the content. The connection was affirmed as Ramey-Gassert et al. stated, "High Personal Science Teachers Efficacy teachers had successful preservice teacher preparation, professional development, and science-related experiences" (p. 304). The results of this study, which affirm the positive correlation between science-teaching self-efficacy, attitude toward the science content, and the choice to effectively teach the science content provides support for the present study's approach to investigate this phenomenon at the elementary level for novice teachers.

Research includes supplementary confirmation that increased teacher self-efficacy leads to successful educators who are comfortable with the science content and as a result put in more effort to understand the content and were willing to take more academic risks when approached with new science content. Intriguingly, the teachers who had the higher STOE scores believed that their students would experience success with the content (Ramey-Gassert et al., 1996). The teachers who had a bad experience with the science content would be hesitant to teach the content because they would feel that their students would have the same bad experience and not perform well, and ultimately be unsuccessful like themselves. Ramey-Gassert et al. (1996) implied that the teachers' personal level of success affects their attitude as well as how the teacher assesses the students' ability to succeed in science. Science content level is a decisive element in the self-efficacy beliefs of teachers. Those who have had good experiences with the with science content and are confident in their knowledge trust that they have the appropriate tools to stimulate the minds of their students to gain the same confidence in the subject matter (Posnanski, 2002).

The self-efficacy of teachers is the determining factor for the potential for success or failure in the classroom. Having the power to encourage students to learn what could be a difficult topic is deeply rooted in the level of self-efficacy (Erdem & Demirel, 2007). Consequently, if the teacher has only negative experiences in the learning process, even through professional development, those negative feelings would prevent the teacher from being an effective instructor and ultimately transfer those negative emotions to the students. According to Erdem and Demirel (2007), "Self-efficacy beliefs provide the foundation of human motivation, well-being and personal accomplishment because unless people believe that their actions can produce the outcomes they desire, they have little incentive to act or to persevere when they face obstacles" (p. 576). In the educational realm, the greater the self-efficacy, the more likely the teacher will transfer the knowledge to their students.

Researchers strongly emphasize the significance of the connectivity between self-efficacy and science content instruction. While science education necessitates only a certain amount of content knowledge for the elementary grades, the emphasis on deficiency and weak, content-specific preparation programs for elementary educators provides for a deficient level of self-efficacy for science comprehension (Riggs & Enochs, 1990). These low self-efficacy levels then progress to an avoidance of the content altogether.

Teacher self-efficacy correlates with student achievement. By studying 103 teachers and 2,148 students, Muijs and Reynolds (2015) found that teacher self-efficacy affected teacher behaviors which were the best predictors of student gains in subject-matter knowledge over the course of a school year. Teacher self-efficacy is the expectation by teachers that their actions can positively impact student outcomes. Self-efficacy affects many aspects of teachers' professional behavior including student goal setting, attribution of student success and failure, as well as classroom management (Ross, 2013). In a research review, Klassen, Tze, Betts, and Gordon (2011) examined 218 empirical research studies published between 1998 and 2009 including studies of teachers in 47 elementary schools. The results of the review indicated that teacher self-efficacy was a major contributor to student achievement (Klassen et al., 2011).

Teacher self-efficacy has a strong, positive influence on student achievement in science (Lumpe et al., 2012). Lumpe et al. (2012) studied 450 elementary school teachers and their 580 fourth grade students. The teacher science self-efficacy scores significantly predicted the students' scores on standardized science assessments. In a review of research, Ross (2013) concluded that there is consistent evidence showing that teacher self-efficacy has a greater effect on student achievement than do most other teacher characteristics.

Theory of PCK

Shulman's (1986) theory of PCK is based upon the thought that "those who can, do. Those who understand, teach" (p. 14). Research based on Shulman's theory of PCK indicated that teachers' PCK is crucial to good teaching and student understanding (Edmond & Hayler, 2013). Shulman (1986, 1987) combined the teachers' subject matter or content knowledge and the knowledge of general instructional methods or pedagogical knowledge to form PCK. PCK is distinctive to teachers and is the basic essence of teaching and is the means by which teachers relate what they know about teaching to what they know about what they teach (Shulman, 1986). This integration encompasses the totality of PCK. According to Shulman (1987), the way of representing and articulating the content to make it understandable to students must include a deep comprehension of not only the subject matter, but also how to teach it. It is this deep comprehension that gives teachers the ability to teach and not simply make them into content-area experts (Guðmundsdóttir, 1987).

Shulman (1986) presented the idea of PCK to the educational arena and began a new era of scholarly research on the topic which focused mostly on the impact of PCK and its impact on effective teaching. In Shulman's (1986) theoretical framework, there are two types of knowledge that efficient teachers must have: (a) content knowledge, which is defined as an intense understanding of the subject; and (b) knowledge of how the curriculum is developed. PCK was further defined by Bruner (1995) as the organization of knowledge that includes the concepts, principles, and theories of certain disciplines. Essential to the situation is content knowledge that encompasses teaching methods, which include the best practices for communicating and representing the content and how students acquire knowledge of the science content. Teachers must balance PCK with general pedagogy. According to van Driel and Berry (2012), Shulman designed the model of pedagogical reasoning that encompasses a cycle of numerous actions that teachers should model to be considered as providing effective instruction. These activities include comprehension, transformation, instruction, evaluation, reflection, and new comprehension. In order to provide proficient instruction, teachers must first comprehend the purpose of the content, know how the subject matter is arranged, and recognize how the subject matter is structured with content outside of the discipline. In order to be effective, teachers must have a deep and comprehensive understanding of the content. Engagement in teaching is essential in helping students enhance literacy, empowering students to both enjoy and utilize their learning experiences, augmenting students' responsibilities to become productive citizens, and inspiring students to believe in and respect others and contribute to the well-being of their community. This further empowers students with the opportunities to improve their inquiry methods to discover new information as well as support students as they develop broader understandings of new information which lead to the developing the students into fully functioning members of society (Veal et al., 2011). According to B. Ford (2007),

> The key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy in the teacher's capacity to transform content knowledge into forms that are pedagogically powerful and yet adaptive to the variety of student abilities and backgrounds. (p. 67)

Teachers must do more than simply understand topics as those comprehended ideas have a transformation process before they are taught. The transformation process must include a combination of processes such as preparation of the material, critical interpretation, idea representation as analogies and metaphors, efficient selection of instructional methods and models, and student material and activity adaptation.

Ozden (2008) conducted a study of Turkish preservice science teachers. The study participants were tasked with writing lesson plans for a 2-hour lesson for fifth grade science topics. Following the writing of the lesson plans, the participants were assessed on their content knowledge of the topic about which they wrote the lesson plan. To conclude the research, the preservice teachers were interviewed about the process of writing the lesson plan and taking the content assessment. Based on the exemplary test scores and the interviews, Ozden concluded the study "emphasized that content knowledge had positive influences on PCK and effective teaching" (p. 639).

For teachers to be effective, they must know what they are teaching. Rodgers and Raider-Roth (2006) found that having PCK allows teachers to decompress the subject-matter knowledge: "Many teachers are knowledgeable of his or her subject matter without necessarily being able to decompress it in a way that makes it accessible to their students" (p. 280). According to Loughran, Milroy, Berry, Gunstone, and Mulhall (2009), there are numerous teachers who are knowledgeable in the subject matter, but are not able to break it down so that it is comprehensible for their students. Pedagogical knowledge acquisition is the way to break down or expand subject matter knowledge. Loughran et al. quoted Shulman when defining pedagogical knowledge as a belief or theory about the teaching and learning process of learning that teachers undergo to possess the level of knowledge that influences instruction. The process includes the ability to effectively design and organize materials, classroom management skills, implementation of problem-solving, teaching and questioning techniques; assessment, problem-solving, and teaching strategies; questioning techniques, and assessment (Halim & Meerah, 2002).

The purpose of Stotsky's (2006) work was to identify and describe the types of knowledge and skills preservice teacher candidates should have acquired in their teacher education programs. Stotsky presented three types of knowledge needed to become a teacher: (a) academic knowledge, which is the subject area content knowledge in their field; (b) generic professional knowledge and skills, which is pedagogic knowledge; and (c) license-specific professional knowledge and skills for teaching in the area of their licensure. The implications of this model suggest that much of the knowledge and skills needed to reach come from content area courses, not education-based courses. Within this claim is the suggestion that better pedagogy in such courses would help develop stronger teachers as they would have acquired greater knowledge and skills in their subject area to be later combined with pedagogic knowledge within methods courses. The work concluded with an argument for teacher education reform being a campus-wide endeavor (Stotsky, 2006).

PCK has additionally been defined as the connection of attitude, knowledge, skill, and motivational variables that teachers must master in order to be successful classroom instructors (Epstein & Hundert, 2002; Kane, 1992; Klieme, Hartig, & Rauch, 2008; Kunter et al., 2013; Weinert, 2001). Teacher success is based upon skills found to be crucial to completing duties and responsibilities related to teaching. These skills are referred to as pedagogical competence. A pedagogically competent teacher has curriculum knowledge and an understanding of their learners' difficulties (Edmond & Hayler, 2013). Mustafa (2013) held that highly competent teachers are able to not only help students academically, but also to help them develop into well-rounded students.

The two components of PCK most frequently the topic of studies are the knowledge of instructional strategies and knowledge of students' understanding of science. Van Driel, Verloop, and de Vos (2011) pointed out that these two components represent the areas of consensus among several authors (Shulman, 1986, 1987; Grossman, 1990; Marks, 1990) and they are featured in the Magnusson, Krajcik, and Borko (1999) model. Zembal-Saul, Blumenfield, and Krajcik (2000) and Zembal-Saul, Krajcik, and Blumenfeld (2002) investigated development of elementary preservice teachers' content representations which included investigations, demonstrations, and analogies; and concern for the needs of learners such as determining students' prior knowledge and incorporating that knowledge into the representations and active engagement of learners combined with informational formative assessments to monitor their understanding.

In order to facilitate lasting student learning experiences, teachers should have PCK of the content area they are assigned to teach (Ball, 2000). This PCK held by the teachers is influenced both positively and negatively by their own school experiences and attitudes. This especially applies to those who teach elementary and primary grades as these teachers do not hold degrees in the various content areas. Johnston and Ahtee (2006) conducted a study involving a physics teaching demonstration. After viewing the demonstration, the participants, who were not science majors, were given a questionnaire. The results indicated that the participants held negative attitudes about the physics content because they did not comprehend the subject matter and could not predict student difficulties or responses (Johnston & Ahtee, 2006).

In a similar study by Halim and Meerah (2002), the knowledge of student understanding and teaching strategies of preservice secondary teachers was researched. These areas were the focus because they are two levels of PCK. The preservice teachers, most of whom were not science majors, underwent interviews about physics topics. The results from the study revealed that PCK levels were severely impacted by the preservice teachers' preparedness for the subject matter (Halim & Meerah, 2002).

Hanuscin, Lee, and Akerson (2011) explored teacher PCK and teaching the nature of science. The study was focused on primary teachers who worked to improve their science PCK in a 3-year professional development program. The purpose of the study was to gain information on how to improve the understanding of the best way to support pre-service and novice teachers. Hanuscin et al. concluded that the participants significantly improved their ability to incorporate the nature of science learning objectives into their lessons and stressed the importance of teachers having deep content knowledge in science. Hanuscin et al. found that science education requires the acquisition of knowledge regarding the nature of science (NOS). This study suggests that there has been some improvement in the area, but "helping teachers successfully teach the nature of science has proven a much greater challenge" (Hanuscin et al., 2011, p. 146). The study highlights the area related to the improvement of PCK in science.

There is a definite need to improve teacher PCK. Garritz (2010) explored the reasoning behind improving content knowledge of teachers, specifically focusing on science teaching, and reflected on the content-dependent instructional conditions necessary to attain conceptual understanding. In addition, Garritz (2010) referred to the cognitive process of teaching and learning as having forgotten about the affective domain research. Garritz (2010) pointed out that the passion of the teacher for the content is one of the most important aspects of teacher content knowledge; that not only should teachers know the content, but they should also have a deep passion for it, which has a contagious impact on the learners.

Students have an amazing sixth sense when it comes to detecting the attitude of their teachers. They can sense when a teacher really enjoys something, which colors the entire emotion of the classroom. This, as stated by Garritz (2010), has a much greater impact than simply knowing the content. Teachers who love their subject matter impart an infectious attraction to the content. Students will sense the excitement of the teacher and not get bogged down by the humdrum nature typically attributed to classroom learning. By bringing this concept to the forefront, the view of PCK is changed and an entirely new meaning is brought to the term.

The discussion of how to improve PCK is explored in much of the literature. Solis (2009) explored the true meaning and role of professional learning in relation to PCK and provided a meaningful reason for providing professional development opportunities to improve the content knowledge of teachers, pointing out the importance of improving content knowledge to better serve the student population. Solis listed numerous models that have been successful in improving teacher content knowledge, supported programs that provide rigorous and relevant content instruction and include a pointed interest in math and the sciences, as those are noted areas of poor student performance. In conclusion, Solis stated that old traditions must be resisted in order to improve the quality of teaching in learning in the critical core content areas. Especially important in Solis's study is the delineation of how PCK is developed. This is an important aspect because it allows researchers and professional development creators to see exactly where improvement is necessary; giving a powerful boost to the argument of why it is an important area to focus attention.

It is commonly acknowledged that deepening content knowledge in and of itself will not inevitably lead to more effective instruction. Effective instruction requires great comfort with the content as well as the knowledge to make science ideas teachable (Loughran, Milroy, Berry, Gunstone, & Mulhall, 2009). Educators should have general pedagogical knowledge and inquiry knowledge as well as the ability to recognize preexisting ideas regarding science topics. They must also be able to facilitate collaborative learning experiences, present activities that are significant and realistic, and possess science content knowledge as well as knowledge of how science ideas are constructed. There must be a deep PCK in addition to the understanding of the intellectual demand of concept comprehensions and these teachers must know about teaching strategies and have knowledge of curriculum materials as well as knowledge of the learners (de Berg & Greive, 2009). Elementary science instruction calls for a vigorous collection of broad and interactive knowledge foundation (Frederik, Van Der Valk, Leite, & Thoren, 2009). Teachers with strong intents, defined science visions, and profound science content knowledge are the most successful (Doster, Jackson, & Smith, 2007). Meaningful transformations in the meta-cognitive ability of students can only be achieved by educators who have a deep and appropriate understanding, as well as conducive attitudes and abilities in regard to science content (Halim & Meerah, 2002).

From these studies investigating elementary teachers' content knowledge, there is evidence that elementary teachers have a deficit in comprehending science concepts. Their understanding is often disjointed, inaccurate, and filled with misconceptions. There are few studies that involve a detailed examination of content comprehension in terms of interconnectedness, depth, organization, and understanding of underlying concepts (Bischoff, 2006; Davis & Krajcik, 2005; Jones, Carter, & Rua, 1999; Smith & Scharmann, 1999). Of these studies, only two—Davis and Krajcik (2005) and Jones et al. (1995)—examined the detailed profile for concepts the study participants actually encountered in their teaching. Smith and

Scharmann (1999) and Solis (2009) collected data that would be useful in determining the depth of understanding, except the data was not analyzed in a way that would lend itself to helping to comprehend the phenomena of the impact of PCK upon teacher practice.

Related Literature

A large amount of existing research is focused on how comprehension of the nature of science affects the elucidation of scientific knowledge and inevitably influences the way in which students reacts to scientific ideas (van Driel et al., 2012). Building upon Bandura's (1986, 1997) theory of self-efficacy and Shulman's (1986, 1987, 1999) theory of PCK, the following sections include further exploration of other areas that have an impact upon the self-efficacy of novice elementary teachers for teaching science. The preparation program that preservice teachers complete, current elementary instructional practices, and elementary science instruction are additional areas that need to be explored to form a complete depiction of the phenomena.

Elementary Teacher Preparation Programs

The concept of self-efficacy plays a large part in the research of preservice elementary teachers' attitudes toward their science teaching ability. Tosun (2000a) showed that low science teaching self-efficacy correlated with preservice elementary teachers not being able to successfully teach science when they entered their own classrooms. This low self-efficacy translated into a lack of effort and energy expended in teaching science. In another study, Appleton and Kindt (2002) found that new elementary teachers with low science teaching self-efficacy often avoid hands-on science teaching methods opting for teaching strategies based on reading and writing. They commented that these science teaching strategies might have been the same ones the teachers had experienced as elementary students.

In light of these findings, researchers have turned to looking at how to enhance the science teaching self-efficacy beliefs of preservice elementary teachers and have found that science methods courses that incorporate hands-on activities and boost science teaching self-efficacy (Jarret, 1998; Palmér, 2016; Schoon & Boone, 1998; Watters & Ginns, 2000). Palmér (2016) also showed that methods courses give the preservice elementary teacher confidence to teach hands-on activities when they begin teaching in their own classrooms. The literature suggests a correlation between the predictive factor of science teaching self-efficacy and the willingness of a preservice elementary teacher to put the work in to teaching science using more student-friendly methods rather than simply reading and memorizing methods of the past (Cannon & Scharmann, 2016; Roberts, 2010). This change is encouraged in elementary teacher preparation programs.

To be effective, elementary teacher preparation programs must focus on certain skills and knowledge (Hagevik, Jordan, & Wimert, 2015). According to Hagevik et al. (2015), in science teacher preparation programs, there must be "the teaching and learning of pedagogical approaches for creative problem-solving, critical thinking skills, scientific and social literacy, ethical awareness and sensitivity for the interrelationships between humans and the global environment, and a commitment to engage in responsible actions" (p. 17).

Some studies indicate there are not many teachers who feel well-prepared to teach science (Hagevik et al., 2015; Hutchinson, Gary, & de la Rubia, 2013). The ability to effectively teach science was a concern in the studies conducted by Hagevik et al. (2015) and Hutchinson et al. (2013). Hagevik et al. (2015) explored the sustainability of beginning elementary science teachers and focused on preservice teachers who had not yet entered the classroom in an actual teaching position. Just before entering their own classrooms, nearly 60% of the teachers felt that they were greatly unprepared to effectively teach science (Hagevik et al., 2015). According to Hagevik et al. (2015),"Teachers have reported a lack of confidence in their preservice teacher preparation for developing the knowledge and skills necessary for teaching" (p. 18). Also of concern, the participants expressed that they had knowledge gaps in science (Hagevik et al., 2015). The participants felt that those gaps were not addressed in the preparation program and they were apprehensive to take the responsibility of science instruction (Hagevik et al., 2015). Many of the research participants expressed either a deep dislike or pure misunderstanding of science content. When reflecting upon their experiences, many of the participants expressed that they struggled in science and could relate their struggle to a specific incident in primary or elementary school that triggered their foul conception of science (Hagevik et al., 2015).

Earlier, Hutchinson et al. (2013) had similar results, but the researchers instituted an intervention. The study participants continued to experience severe deficiencies in regard to having the confidence to teach science. In this study, preservice teachers participated in a workshop specifically geared toward science education. Hutchinson et al. (2013) hoped to positively impact the experience of the preservice teachers by offering them the opportunity to participate in a STEM experiential learning community. The purpose of the learning community was to integrate science content into the professional development of non-science and elementary education majors. As a result of this effort, Hutchinson et al. had

> begun to examine how students' content knowledge changes and collecting quantitative feedback on the effectiveness of the course, while combining it with student views of the nature of science gives a more complete picture of the science these teachers intend to teach in their future classrooms. (p. 14)

Appleton (2013) encouraged the modeling of science teaching for teacher preparation programs. The participants in the study were given specific instruction on how to teach science content. The preservice teachers reported that they learned to teach science like scientists and shared that they grew by participating in the study. They increased their confidence and sense of self as teachers of science, they became aware that teaching science requires significant work input and review of current practices, and they began to become more comfortable with the science content (Appleton, 2013). Through the experience of delving into the content, the participants were able to gain a meaningful amount of self-confidence.

Halim and Meerah (2002) conducted a study with New York teachers and students in which they compared the reading and math scores for the students of first-year teachers. They then added the certification route that the teachers pursued, including fully certified, uncertified, or alternatively certified. The alternatively certified category included certification routes that differed from the traditional college teacher certification pathway. Halim and Meerah (2007) compared the academic qualifications of the novice of first-year teachers. Using a regression formula that calculated student achievement, effectiveness, and student background factors, they found "little difference in the average academic achievement impacts of certified, uncertified and alternatively certified teachers" (Halim & Meerah, 2002, p.221). The study findings also showed that each preparation pathway lacked the appropriate amount of content knowledge to positively impact student achievement (Halim & Meerah, 2002).

Additionally, Pardham and Wheeler (2010) found that completed courses and attained degrees contribute significantly to student achievement. The research revealed a quirk that showed that content-specific coursework and degrees are more beneficial at the secondary level than at the elementary level for many content areas. In the study of a sample of eighth grade teachers, classroom strategies, goals, preparedness, professional development participation, and credentials were assessed. A three-level hierarchy was utilized to categorize the teachers according to the level of coursework they had in the content area and it was discovered that "regular or temporary certification alone was not significantly related to preparedness to teach science although certification to teach science was associated with increased levels of preparedness to teach science topics" (Pardham & Wheeler, 2010, p. 99). More importantly, it was discovered that teachers without a significant science background, such as a major or minor in the content, reported lower levels of preparedness to teach science than did those with a more extensive science background. The Pardham and Wheeler (2010) study shows that teachers with science content knowledge are better equipped in the classroom than those without the same level of basic content knowledge.

In the semester or two before entering the student-teaching phase of the teacher education program, elementary student teacher candidates typically enroll in a science methods course. The overall purpose and strategic organization of the science methods course is imperative in helping refine the craft of science teaching and encouraging a strong sense of science teaching self-efficacy. Anderson, Van Weert, and Duchâteau (2002) provided useful insight into the nature of science methods courses from an operational definition perspective, and context within the total teacher education program perspective. The purpose of Anderson, Van Weert, and Duchâteau's (2002) study was to report research-based definitions and ideas of the role and logistics of science methods courses, construct a new definition that integrates those purported in the literature, and provide suggestions into the implementation of a new definition of science methods courses while noting the pitfalls that may ensue.

Kelly (2006) encourages developing an elementary science methods course that is constructivist-based after a four-year study of this class content and requirements. Kelly identifies the benefits of developing learning centers, peer teaching experiences, and practical experiences with the learning styles of elementary students. This research adds to the mosaic of information that suggests that a holistic, constructivist-oriented science methods course can enhance PCK and increase science teaching self-efficacy. More importantly, Kelly (2006) suggested that a possible result of an effective science methods course is the transferring of the constructivist learning by preservice elementary teacher candidates to constructivist-framed teaching once those candidates become in-service teachers.

Carter and Sottile (2002) examined the critical factors that influence dispositions of preservice elementary teacher candidates as a result of participating in a constructivist-based science methods course. The results of the examination identified that the constructivist orientation increased the levels of science teaching self-efficacy amongst the preservice elementary teacher candidates. A relevant implication of this work is the suggestion that improvement in science-teaching self-efficacy, as a subsequence of a constructivist-framed methods course, will be seen longitudinally when the preservice teachers become in-service teachers. This point is the reason for continued research and efforts to reform science teacher education and preparation (Czerniak & Haney, 1998). Johnson, Kahle, and Fargo (2007) identified the relationship between constructivist-based science methods courses and the levels of science teaching self-efficacy. More specifically, Johnson et al. showed how an active learning and teaching style affects preservice elementary teacher candidates' beliefs and attitudes of science teaching. The results of the relationship analysis showed that well-designed methods courses that incorporate hands-on activities with opportunities to construct new ideas about science intertwined with teaching and learning strategies had positive impacts in elevating levels of science teaching self-efficacy (Johnson et al., 2007).

Driver and Oldham (1986) provided insight into science curriculum development and have become advocates for the establishment of better curriculum development in the area of science, and described the undercurrents of a constructivist approach to learning and the effectiveness of student learning that it is intended to achieve. Driver and Oldham gave an overview of the condition of elementary science curriculum and how it needs to be amended as the concern for student epistemology gains momentum and as the demand increases for better-taught science lessons. Constructivist-oriented learning has been the answer to these issues and remains the major part of the reform drive in science education. Preservice elementary teacher candidates must be prepared to teach along the constructivist-oriented pedagogic line. Teacher education programs have not yet fully incorporated this concept and are being scrutinized for graduating unsuccessful and incompetent science teachers as a result (NRC, 1996).

The NRC (1996) expressed concern about science teaching at the elementary level utilizing the National Science Standards and offered suggestions as to how teacher preparation programs could institute new ways to improve the quality of science education by producing better-prepared candidates from their program of study. One option offered was to have collaboration between the education programs and the institutions' science departments. Tilgner (1990) acknowledged that there are severe challenges facing science education at the elementary level. Tilgner sought a solution to the perceived shortcomings of teacher preparation programs and provided a list of characteristics that should be used by effective elementary science programs to modify the practices in teacher development. Tilgner noted that preservice elementary teacher candidates had incompetent and marginal understandings in science and have only a slight interest, if any, in teaching science. Because of this, Dembo and Gibson (1985) found the global condition of teacher preparation programs in training for science education was in peril and hovering on the edge of demise unless there was tremendous and immediate reform in the way teachers are prepared to teach science at the elementary level.

Olson (2017) and Appleton (2006) voiced concern about the status of elementary science teacher preparation and practice. Their study was focused on the solutions to meet the current understandings of teaching and learning and the effectiveness of well-prepared, science-knowledge confident, and self-efficacious preservice elementary teacher candidates entering the field post-graduation as in-service teachers. Even though it seems like a dark cloud hanging over elementary science teacher preparation programs, there is indeed a bright ray of light that gives hope to reversing the negative perceptions of the last few decades by developing and employing exceptional science teachers at the elementary level. One method shown to improve teacher quality is for teachers to have a stronger sense of science teaching self-efficacy (Tschannen-Moran, Woolfolk-Hoy & Hoy, 1998).

According to Shulman (1986), the obligatory skills essential to become an elementary teacher are often simplified to having the aptitude to be around children and the disposition to share knowledge. Learning to teach has also been described as the result of observation traineeship. It is believed that prospective teachers' preconceived notions and ideas are much more powerful than is teacher education training. Their views and ideas are formed by their experiences as learners over the years and are deeply rooted. Since this perception renders teaching to be an art rather than a learned and developed skill, the value of teacher preparation programs, specifically methods courses, have diminished importance even to the degree of trivialization. Prospective teachers frequently enter science methods courses with biased views, values, beliefs, and representations of good teaching skills (Huinker & Madison, 1997) and how to teach science. Consequently, difficulties arise in helping prospective teachers view and do science in effective ways. The antidote, according to empirical data, is for science methods courses and specialized content courses to provide appropriate scaffolds to enable prospective teachers to move beyond cute, manic activities (T. H. Nelson & Moscovici, 1998) and to initiate thinking about teaching and learning science more meaningfully (Barreto-Espino, 2009; Haefner & Zembal-Saul, 2004; Huinker & Madison, 1997). Encouraging teachers to move beyond manic activity is possible, as Hayes (2002) determined that science methods courses in combination with field experiences can help prospective teachers overcome fears of classroom management, begin to interpret the multiple definitions of inquiry, and develop appropriate strategies and knowledge for asking valuable questions when engaging children in scientific investigations.

Johnson et al. (2007) pinpointed the connection between constructivist-based science methods courses and stages of science teaching self-efficacy. More specifically, they confirmed how active learning and teaching style affects preservice elementary teacher candidates' beliefs and attitudes about teaching science (Johnson et al., 2007). The results of the analysis proved that well-designed methods courses, which included hands-on activities and opportunities to develop new ideas about science entwined with teaching and learning strategies, had a positive impact upon elevating levels of science teaching self-efficacy.

Unfortunately, many scholars view science methods courses as too little, too late. They have challenged this notion by claiming that methods courses have an influence on prospective teachers' knowledge and beliefs of effective science teaching and that many theoretical and practical aspects should be considered when thinking about science methods courses. For example, Abell, Smith, and Volkmann (2006) claimed that well planned and executed science methods courses can confront prospective teachers' prior knowledge and experiences and can help them conceptualize new explanations that are more consistent with the aim of the National Science Education Standards (NSES).

An additional piece of evidence that demonstrates the effect of science methods courses in an empirical study in which Schwarz, Hershkowitz, and Azmon (2006) examined a specialized methods course that used an engage, investigate, model, apply (EIMA) teaching framework. The EIMA framework, used in the context of lesson planning, had results that demonstrated that most prospective teachers were able to connect planning practices with current science education reforms. In addition, results suggested that the use of the EIMA framework in the science methods course produced changes in prospective elementary teachers teaching orientations: from didactic and activity driven toward inquiry and guided inquiry (Swarz et al., 2006).

The recommended degree program for elementary school teachers in nearly all state university systems prescribe completion of a set curriculum that provides many candidates with sufficient science content knowledge to teach science in a self-contained classroom setting. These programs usually include four survey-level classes, with one each in life science and earth science, and two classes in the physical sciences. Students are required to complete the course with a grade of C or better. While content and pedagogy courses abound, only a few courses are dedicated to science (Bleicher, 2007, Lambert et al., 2012). As a result of the lack of courses, many preservice teachers have a low level of science self-efficacy and they are intimidated by the content (Lambert et al., 2012, Pajares, 1993; Tosun, 2000b). The majority of preservice elementary teachers have limited science experience and most of them have found the courses difficult or frustrating (Lambert et al., 2012).

Researchers suggest that development of preservice teachers' science self-efficacy is critical to address before they enter methods courses (Avery & Meyer, 2012; Hechter, 2011). High science self-efficacy supports a smooth transition into science methods courses and student teaching (Bautista, 2011; Gunning & Mensah, 2011). Menon and Sadler (2016) found that preservice teacher education programs must be designed consistent with the way teachers are expected to teach. Specialized content courses specifically designed for elementary teachers can serve as appropriate contexts for learning science that increases the preservice teachers' science self-efficacy (Knaggs & Sondergeld, 2015; Narayan & Lamp, 2010). Specialized content courses have advantages over traditional content courses because they provide opportunities for engagement in science learning as well as effective science teaching practices (Menon & Sadler, 2016).

Classroom Practice and Teacher Experience

It is commonly acknowledged that deepening content knowledge in and of itself will not inevitably lead to more effective instruction (Davis, 2006). Effective instruction requires great comfort with the content as well as the knowledge to make science ideas teachable (Bouillon & Gomez, 2001). Educators should have general pedagogical knowledge and inquiry knowledge as well as the ability to recognize pre-existing ideas regarding science topics. They must also be able to facilitate collaborative learning experiences, present activities that are significant and realistic, possess science content knowledge as well as knowledge of how science ideas are constructed. There must be a deep PCK in addition to the understanding of the intellectual demand of concept comprehensions and these teachers must know about teaching strategies and have knowledge of curriculum materials as well as knowledge of the learners (Davis, 2006).

Elementary science instruction calls for a vigorous collection of broad and interactive knowledge foundation (Davis & Krajcik, 2005).

Elementary teachers who are at the early stages of their careers have challenges that impact their science teaching practices (Gustafson, Guilbert, & MacDonald, 2002). The challenges include insufficient professional development opportunities for science content, insufficient materials and time for hands-on, inquiry-based instruction and activities, and the lack of administrative support (Gustafson et al., 2002). These early career experiences construct the formative foundation for their self-efficacy for teaching science, as well as their overall teaching (Gibson & Dembo, 1984; Rich & Almozlino, 1999; Tschannen-Moran & Woolfolk Hoy, 1998).

Rich and Almozlino (1999) studied the relationship between teachers' experience, their goal setting for their students, and their instructional decisions to help students reach those goals and found that experienced and novice teachers have three areas of goals for their students: academic, personal, and social. The new, inexperienced teacher tended to lean toward the academic goals while the veteran teachers showed preference for personal and social goals. Rich and Amozlino explained that the difference between veteran and novice teachers likely arises because novice teachers are more comfortable with academic goals. This is sensible as the academic performance of their students is closely monitored by the administrators while personal and social growth are not viewed as an evaluation piece. Rich and Amozlino found a difference in the goal preference between veteran and novice teachers, and their supportive actions were varied. Barreto, Zembal-Saul, and Avraamidou (2014) found that novice teachers exhibited dissonance between their beliefs and practices and are more likely to not follow through with their goals.

Nye, Konstantopoulos, and Hedges (2004) studied the impact of teachers on student achievement using teacher experience level, teacher education level, and class size, and found that teacher experience was the most impactful for teachers early in their career. The teachers studied were divided into those with 3 or less years of teaching experience and those with more than 3 years of teaching experience. Darling-Hammond (2000) stated that the possible reason for the experience trend is that older teachers may not continue to grow and learn. Nye et al. defined student achievement by performance on the standardized assessments that are given in Grades K–3. Students whose teachers had more than 3 years of experience performed significantly better than their peers with novice teachers (Nye et al., 2004).

Klecker (2002) examined data from the 2000 NAEP mathematics assessment from Kentucky, Tennessee, and Texas to determine if teacher experiences impact student achievement. The differences found were statistically significant, but the difference in scores between the two groups was small enough to be considered insignificant (Klecker, 2002). Terry (2014) found similar outcomes when studying the relationship between teacher experience and student performance on standardized elementary math and language arts assessments in Missouri. There was a weak correlation found for the fifth grade math test, but there were no other statistically significant relationships found for the other assessments (Terry, 2014).

Ghaith and Yaghi (1997) employed Gibson and Dembo's (1984) Teacher Efficacy Survey (TES) to compare attitudes and self-efficacy toward innovation of veteran and novice teachers. This correlational study showed that teacher efficacy and willingness to use new, and innovative strategies were negatively correlated with teacher experience (Ghaith & Yaghi, 1997). These findings contradicted Guskey's (1988) findings which showed that experienced teachers were more likely to engage in innovative and cutting-edge practices. Ghaith and Yaghi's findings of a negative correlation between self-efficacy and teacher experience was consistent with earlier research that suggested teachers with more experience feel that their influence upon student learning is limited by factors that they cannot control (Guskey & Passaro, 1994).

Tschannen-Moran and Hoy (2007) sought to comprehend how self-efficacy changes throughout a teacher's career as well as the varied backgrounds of self-efficacy for novice and veteran teachers. In order to complete their research and measure general self-efficacy, Tschannen-Moran and Hoy (2007) employed the Teacher Sense of Efficacy Scale (TSES). Their research showed that veteran teachers had higher levels of self-efficacy than did the novice teachers. Veteran teachers also had higher levels of efficacy with instructional strategies and classroom management, but there was no significant difference for student engagement (Tschannen-Moran & Hoy, 2007). The study showed that the self-efficacy of novice teachers is greatly influenced by contextual factors such as resource availability, administrative persuasion, and stakeholder support.

The Status of Science in Elementary Education

Inadequate student achievement in science is a serious concern in the United States as well as other parts of the world. Within the past 20 or so years, the National Science Teachers Association (NSTA) has dedicated an issue of its professional journal each year to research on achievement gaps in science (Metz, 2016) which indicates far-reaching concern in the science teaching community. The results of the 2011 National Assessment of Educational Progress (NAEP) in science revealed that greater than 65% of students in the United States were at performance levels below proficient and 2% were performing at an advanced level of achievement (Synder & Dillow, 2012). Within the last 5 years, American researchers have conducted many studies with the focus of improving student achievement in science

(Bolshakova, Johnson, & Czerniak, 2011; Holmes, 2011; Israel, Myers, Lamm, & Galindo-Gonzalez, 2012; Pinder, Prime, & Wilson, 2014; Pruitt & Wallace, 2012; Santau, Maerten-Rivera, & Huggins, 2011; Scott, Schroeder, Tolson, Tse-Yang Huang, & Williams, 2014; Shymansky, Wang, Annetta, Yore, & Everett, 2012; Wyss, Dolenc, Kong, & Tai, 2013). The volume of recent research establishes low student achievement in science as a topic of widespread concern that is worthy of study at the local level. All of the researchers were interested in finding ways to improve student achievement.

The United States instituted goal of public education was to provide every student the best instruction possible in every subject (G. D. Nelson & Landel, 2007). The NSTA (2011) confirmed that the purpose of elementary science instruction is to assist students in developing problem solving skills that encourage them to have in integral part in the scientific and technological world. A national emphasis on STEM education requires an increase in the priority level of science education (Duschl, Schweingruber, & Shouse, 2007; Kilpatrick & Quinn, 2009). Owens (2009) found that there is growing concern in regard to American science education as there is increasing demand for a qualified and competent workforce to fill the careers in the technical and scientific fields. Rudolph (2014) mentioned that economic matters have eclipsed the justification for science instruction. Former President Obama (2009) reiterated these points: “Science is more essential for our prosperity, our security, our health, and our way of life than it ever has been” (para. 10). Attention to the issue of science instruction at the federal level has been heightened by the President’s Council of Advisors on Science and Technology (Olson & Riordan, 2012) informing the education policy-makers of the need for more STEM field graduates.

Elementary science instruction has been through the waves of heightened attention and reform efforts over the past years (Century, Rudnick, & Freeman, 2008). In 1892, Charles Eliot and the Committee of Ten noted that science was effective for developing the mental abilities of students and recommended that hands-on methods using scientific tools should be utilized when teaching science (DeBoer, 2000). In the early 20th century, John Dewey (1910) described science instruction as including ready-made materials with which students needed to become familiar and was disconcerted about the lack of thinking required.

During the late 1950s, the Race to Space following the launch of the Russian satellite Sputnik created a tremendous and unprecedented focus on American math and science instruction. The time period was characterized by a rush to improve science education to maintain national security (Century et al., 2008). As the hoopla over the space race began to die down, there was less emphasis on science instruction and more emphasis on science literacy along with the role of science in a modern society (DeBoer, 2000). The focus has again returned to instruction in science. International competitiveness has shifted from being the first into space and preserving national security to preserving economic viability and innovation (Century et al., 2008).

The advocacy of science inquiry and practice-based instruction has occurred for over a century in the science education reform movements yet Century et al. (2008) found that most elementary schools do not follow that model for instruction. Sowder and Harward (2011) concluded that science inquiry was only evidenced in 2% of the elementary classrooms included in their study. Tilgner (1990) concluded that many elementary teachers still construe their instructional role as one who passes out scientific facts. Fifield, Grusenmeyer, and Ford (2014) surmised that preservice elementary teachers had a very negative response to inquiry-based teaching comparable to mourning the death of a loved one. This resistance to embrace science teaching is troubling because the science reform efforts are centered around elementary science instruction and impact instructional efforts at the secondary level (Levy, Pasquale, & Marco, 2008; NRC, 2012). The Next Generation Science Standards (NGSS) frame the latest science education reform effort. The NGSS address the issue of making the practice of science above the simple acquisition of science facts (NRC, 2013).

Summary

Chapter Two included a review of the current literature on the self-efficacy of novice elementary school teachers. The importance of PCK was explored and the lack of science instructional methods in teacher preparation programs was conveyed. PCK is the basic essence of teaching because it is the determining factor in teacher effectiveness. A gap exists in research devoted to the experience of novice elementary school teachers who completed a traditional teacher preparation program at a college or university.

CHAPTER THREE: METHODS

Overview

The purpose of this phenomenological study was to understand the perceptions of self-efficacy in science PCK for novice elementary school teachers at five elementary schools in central Georgia. A qualitative transcendental phenomenological approach was used to address the research questions. Chapter Three includes description of the design and rationale for the study. In addition to the procedures and analysis for the study, my role as the researcher is described along with a description of the setting and participants. An explanation of the data collection and analysis methods is also included. To conclude this chapter, the study's trustworthiness and ethical considerations are provided.

Design

The transcendental phenomenological qualitative approach was appropriate for this study of the perceptions of self-efficacy in science PCK for novice elementary school teachers because the nature of this study was descriptive, and its purpose was to make meaning of participants' perceptions (Gall, 2013). Further, because human experiences, beliefs, and insights are, by nature, dynamic, the interpretive, naturalistic approach applied in qualitative research designs was necessary for data interpretation. Additionally, a phenomenological approach allowed for the in-depth study of several teachers who shared the same experience of completing a traditional teacher preparation program and have fewer than 4 years of teaching experience. Finally, a phenomenological approach allowed me to analyze interviews, survey results from the STEBI-A, and analyze focus group interviews to get to the heart of what teachers think, feel, and believe are the concerns and strengths inherent to teaching science at the elementary level.

A transcendental phenomenological qualitative design was applied because the purpose of the study was to uncover the experiences in teacher self-efficacy from the viewpoints of the teachers. According to Bogdan and Biklen (2003), qualitative research shows "how people such as teachers, principals, and students think and how they came to develop perspectives they hold" (p. 3). When referring to qualitative data, Bogdan and Biklen (2003) explained that the researcher is the main instrument in the data collection process. Therefore, this qualitative study was conducted using the transcendental phenomenological approach. The transcendental phenomenological approach allowed me to see the phenomenon through an unknowing and impartial lens (Sheehan, 2011). In addition, I used epoché in the study. Husserl (1931) used the term *epoché*, meaning "to avoid or to abstain from," in describing the process of consciously identifying and restricting the researcher's own thoughts and setting aside current opinions and beliefs (Moustakas, 1994). According to Blum (2012), through epoché, transcendental phenomenology allows "things, events, and people to enter anew into consciousness, and to look and see them again, as if for the first time" (p. 1032).

Research Questions

Three research questions (RQs) were used to guide this study.

RQ1. How do novice elementary school teachers of Grades 3–5 in Laughlin County Elementary, Moore County Elementary, Porter County Elementary, Sander County Elementary, and Unity County schools perceive their self-efficacy in teaching science?

RQ2. How do novice elementary teachers in Georgia perceive their self-efficacy in science content knowledge?

RQ3. How do novice elementary teachers in Georgia perceive their preparedness for teaching science after completing a preservice teacher preparation program?

Setting

The settings for the study included Laughlin County Elementary, Moore County Elementary, Porter County Elementary, Sander County Elementary, and Unity County Elementary schools in central Georgia. The school names used in the study are pseudonyms to protect the identities of the study participants. These schools shared similar demographics.

Laughlin County Elementary School (LCES) has a student population of 658 students. Of these 658 students, there are 400 Caucasian students, 195 African American students, 34 multiracial students, 27 Hispanic students, and two Asian/Pacific Islanders students. There are 305 female students and 353 male students. The disabled population consists of 83 students. The teacher population consists of 38 teachers, 34 of which are female and four are male. There are 25 Caucasian teachers, 12 African American teachers, and one Hispanic teacher. The teachers have a variety of educational levels: 14 have bachelor's degrees, 23 have master's degrees, and 10 have specialist degrees. There are 15 teachers who have less than 10 years of experience.

Moore County Elementary School (MCES) has 637 students with 295 female students and 342 male students. There are 380 Caucasian students, 211 African American students, 27 multiracial students, 17 Hispanic students, and one Asian/Pacific Islander student. The school has a disabled population of 120 students. There are 51 teachers at MCES with 46 female teachers and five male teachers. Of the 51 teachers, there are 40 Caucasian teachers, 10 African American teachers and one multiracial teacher; in addition, 26 teachers have less than 10 years of experience with two currently in their first year of teaching. Most of the teachers have bachelor's degrees (23), but there are 22 teachers who have master's degrees, three who have specialist degrees, and three who have doctoral degrees.

Porter County Elementary School (PCES) has a student population of 723 students with 374 males and 349 females. There are 619 Caucasian students, 61 African American students, 23 multiracial students, 15 Hispanic students, and five Asian/Pacific Islander students. The disabled population consists of 77 students. PCES has 47 teachers with 43 females and four males. The entire teacher population is Caucasian. There are 13 teachers with less than 10 years of experience and one teacher in their first year at the time of the study. Of the teachers, 14 have bachelor's degrees, 23 have master's degrees, and 10 have specialist degrees.

Sander County Elementary School (SCES) has 630 students with 292 females and 338 males. There are 398 Caucasian students, 161 African American students, 45 Hispanic students, 24 multiracial students, one Asian/Pacific Islander student, and one American Indian student. The school has 86 disabled students. SCES has 39 teachers, with 10 having less than 10 years of experience and one completing their first year of teaching at the time of the study. Of the 39 teachers, 34 are Caucasian, three are African American, one is multiracial, and one is Hispanic. There are 17 teachers with bachelor's degrees, 13 with master's degrees, eight with specialist degrees, and one with a doctoral degree. There are 37 female teachers and two male teachers.

Unity County Elementary School (UCES) has 674 students of which 365 are Caucasian, 237 African American, 35 Hispanic, 33 multiracial, three Asian/Pacific Islander, and one American Indian/Alaskan. There are 346 females, 328 males, and 109 students with disabilities. The 40 UCES teachers have varied levels of education; 15 have bachelor's degrees, 12 have master's degrees, 12 have specialist degrees, and one has a doctoral degree. There are 34 female teachers, six male teachers; 37 are Caucasian and three are black. There are 10 teachers with less than 10 years of experience on the UCES faculty.

These central Georgia elementary schools do not use a team-teaching model. Schools that do not use the team-teaching model were preferred for this study because the teachers in those schools have the responsibility of teaching all four required content areas instead of focusing on two content areas. All of the elementary schools identified for the study were Title I schools that receive financial assistance due to high numbers of students that come from low-income families.

Participants

The participants in this study were purposefully selected from LCES, MCES, PCES, SCES, and UCES schools (Creswell, 2013a). The participants included certified elementary educators who have less than 5 years of teaching experience and gained teacher certification through a traditional teacher preparation program. It was my desire to have participants who were not enrolled in, or who had not completed any graduate level coursework related to the science content to ensure that the participants had not received any instruction other than what is covered in the traditional teacher preparation program. I chose to study these individuals because I wanted the participants to have similar educational experiences and backgrounds and to have those who only possess the educational experiences from a preservice education preparation program. I interviewed 12 participants when data saturation was reached (Creswell, 2013b; van Manen, 1990). Participants were recruited based on personal invitations to those teachers meeting the participant parameters in the chosen schools.

The teacher demographic for the selected schools in the central Georgia area was predominantly young, middle class, single Caucasian females. There were very few minority or male teachers who met the participant criteria. Of the 47 teachers who had fewer than five years of teaching experience, there were 37 females and seven males. There were 23 Caucasian females, 12 African American females, one Hispanic female, one multiracial female, five

Caucasian males, and two African American males. Purposeful sampling was used to ensure diversity of study participants.

Procedures

Following a successful proposal defense, I applied to the Liberty University Institutional Review Board (IRB) for approval of the study (see Appendix A). I then sought permission from the study sites to contact teachers for participation in the study. After all approvals were received, I commenced data collection and analysis. To ensure the interview questions were coherent, I conducted a pilot study of the interview questions with a small sample of veteran educators who otherwise fit the selection criteria. The pilot study participants provided feedback on both the interviewer technique and the interview questions.

After completion of the pilot study, purposeful sampling was conducted to recruit participants for the study. I contacted CCES, LCES, MCES, PCES, SCES, and UCES in central Georgia and asked for a list of employee contact information for those who met the qualifications for study participation. Informed consent letters were emailed to potential participants to share the purpose of the study and provide the type of involvement needed for study participation (see Appendix B).

Following the collection of the informed consent letters, participants were selected using purposeful sampling to get a variety of participant demographics. I attempted to vary the participants by ethnicity, gender, and college attended as much as possible. The reasoning for purposeful sampling was to gain perceptions based on multiple experiences and backgrounds. I then contacted selected participants to schedule interview and survey sessions.

During the individual interview sessions, I recorded my reflective notes that included descriptive elements to detail the experience. The individual interview sessions lasted approximately 45–60 minutes. The individual interviews were audio-recorded using multiple devices and my individual interview reflective notes were written during the interview to note gestures or facial expressions that would add to the understanding of the individual interview transcript (van Manen, 1990). Following the individual interviews, participants were asked to participate in a focus group interview. The focus group interview included various writing prompts to facilitate open discussion among the participants. I transcribed all interview recordings.

The Researcher's Role

My motivation for this study stemmed from my personal career experiences. I am currently a secondary science teacher with a specialization in physics and chemistry. My undergraduate studies were in biochemistry and molecular biology. I became a public-school educator after working in private industry for 6 years. Having an in-field bachelor's degree, I was able to become alternatively certified to teach science.

Since beginning my teaching career, I have struggled with ensuring my students reach the level of achievement that is expected of them through state-mandated, high-stakes testing. I recognized that many of my students were not prepared to acquire the course level content knowledge when they entered my classroom as they were lacking basic, elementary science skills and knowledge. On content pretests to assess previous knowledge, I found that less than 20% of my students had the prerequisite knowledge necessary to be successful in the upper level science courses. My frustration led me to begin research on the stages of science education. I found that elementary teachers are only required to take one basic science course during their teacher preparation program. Wanting to know how confident these traditionally prepared teachers felt, I searched the literature for studies. It was then that I found a gap in the literature.

I planned to conduct a qualitative phenomenological study because I wanted to hear the voices of the teachers regarding their experiences of being new to the teaching profession and having to teach the science content. I wanted to discover if they had any frustration or discouragement due to being unprepared to complete their assigned job duties. To maintain the integrity of the study, I did not have any professional or personal interactions with the participants or the site other than the interactions that were part of the study.

Data Collection

Data collected for this study included individual interviews, the STEBI-A (Riggs & Enochs, 1990), and a face-to-face focus group interview.

Individual Interviews

I conducted individual interviews with the study participants. The participants answered 12 open-ended questions about their backgrounds, science self-efficacy, and self-efficacy for teaching science to elementary students (see Appendix C). I determined the need for follow-up interviews based upon the results of the initial interviews. Pseudonyms were used to track participants for data analysis and to protect the confidentiality of the participants, using van Manen's (1990) advice "to be constantly mindful of one's original question and thus to be steadfastly oriented to the lived experience which makes it possible to ask the 'what it is like' question" (p. 42).

I followed van Manen's (1990) guidance for development of the standardized open-ended interview questions. The standardized open-ended interview questions were as follows:

1. Please summarize your current teaching assignment, teaching credentials, and education?
2. Describe your confidence in science content knowledge. (RQ1)

3. How comfortable are you with teaching science topics? (RQ1)
4. How effective do you believe you are in teaching science? (RQ1)
5. How do you activate or stimulate the science learning experience? (RQ2)
6. How do you prevent student misconceptions in the science content? (RQ2)
7. What additional learning materials or resources do you include in your science lessons? (RQ2)
8. Describe your experience with science content when completing your teacher preparation program. (RQ3)
9. What science courses were required in your teacher preparation program? (RQ3)
10. How prepared do you feel to teach science after completing your preparation program? (RQ3)
11. What do you feel could have helped to better prepare you to teach elementary science? (RQ3)
12. What else would you like to share with me about your experiences?

The purpose of the first question regarding background information was to establish a comfortable and relaxed atmosphere for the interview as well as to gain meaningful information that may impact the beliefs of the participants. Interview Question 1 was developed to gather this necessary information. According to Kvale (1996), at the most basic level, interviews are conversations between two people. Thus, while they are aligned to the first research question, Interview Questions 2 through 4 were designed to elicit introspective responses (Patton, 2005).

Interview Questions 2 through 4 served to probe the participants' beliefs about their ability to teach science, which aligns with RQ1. Providing humans are fundamentally "intelligent systems" and have a distinctive ability to observe the world around them, these nonempirical questions gave an enhanced understanding of participants' perceptions (Stufflebeam, Madaus, & Kellaghan, 2006, p. 3). The questions are similar, yet the distinctions between confidence and perceived effectiveness address different components of Bandura's (1997) self-efficacy theory. Confidence is an assumed belief and feeling that may be informed primarily by enactive mastery experiences and emotional arousal while effectiveness is more objective and can be shaped through indirect experiences and oral coaxing (Bandura, 1997; Kelleher, 2016).

Interview Questions 5 through 7 served to probe the participants for defining information on how they translated their efficacy in the classroom and how their classroom practices were structured when teaching science. Teacher efficacy directly relates to classroom practice. Researchers have long held that it is self-efficacy that makes a teacher most effective in the classroom (Guo et al., 2012). Evaluation of classroom practice gave a deeper understanding to the research by revealing actual methods the teachers use to teach the science content and further define the role that self-efficacy plays in how teachers actually teach their students. These interview questions align with RQ2.

Interview Questions 8 through 11 were intended to gain information about the teacher preparation program the participants completed. These questions required participants to recall the training they have received in their teacher preparation program. These questions were imperative as they served to glean knowledge of personal experiences and provided information directly related to RQ3 regarding how well-prepared the novice elementary teachers felt upon entering the classroom.

Interview Question 12 is the final question and served to wrap up the interview. This question was designed to allow the participants to include any further information that they felt was important to the interview.

STEBI

The Science Teaching Efficacy Belief Instrument (STEBI-A) is a tool to study elementary teachers' beliefs toward science teaching and learning. The STEBI-A (Riggs & Enochs, 1990) was used in the present study to provide improved triangulation of the other data sources, concerning the overall efficacy the novice elementary teachers believed they possessed as science instructors. As noted, the purpose of using the STEBI-A (Appendix D) was to enhance triangulation with the responses received from the participants during the individual interviews and focus group interviews. Moreover, data from the STEBI-A were not analyzed quantitatively. The STEBI-A provided a more complete perspective of elementary science teaching since it allowed for the investigation of teacher belief systems to triangulate the present research, which included teachers' attitude and behaviors in regard to teaching science. As such, the STEBI-A added deeper understanding of the participant responses. The Science Teaching Efficacy Belief Instrument (STEBI-A) has 25 Likert-scaled statements that relate to personal beliefs about teaching science with responses of *strongly agree* (SA), *agree* (A), *uncertain* (UN), *disagree* (D), or *strongly disagree* (SD). Sample statements that the teachers were asked to rate were as follows:

1. When a student does better than usual in science it is often because the teacher exerted a little extra effort. (RQ1)
2. I am continually finding better ways to teach science. (RQ2)
3. Even when I try very hard, I don't teach science as well as I do most subjects. (RQ1)

4. When the science grades of my students improve, it is most often due to their teacher having found a more effective teaching approach. (RQ2)
5. I know the steps necessary to teach science concepts effectively. (RQ2)

Focus Group Interview

A focus group interview was facilitated following the individual interviews and belief instrument interview. A face-to-face focus group interview allowed me to interact with the participants at one centralized time and place. The focus group interview allowed for the exploration of complex, multilayered concepts from the perspectives of the participants. The use of a focus group interview added additional in-depth information to the interview data through the interaction of the participants (Creswell, 2013a). If needed, an online alternative was utilized to provide convenience for the study participants. The focus group interview prompts were fine-tuned following the individual interviews in order to probe further into the shared experiences of novice elementary teachers (see Appendix E). The focus group interview questions were as follows:

1. Please tell us your name and how many years you have been teaching.
2. Think back to the beginning of your first-year teaching. Describe how well-prepared you felt to teach science. (RQ3)
3. What changes did you make to the way you taught science after your first-year teaching? (RQ1)
4. How has your confidence changed from the beginning of your first-year teaching to this point? (RQ2)
5. How do you feel your confidence in teaching science impacted your teaching methods? (RQ1)

The focus group interview questions aligned with the research questions to gain a deeper understanding of the teachers' experiences. Focus Group Question 1 was designed as an icebreaker to get the participants familiar with each other. Focus Group Question 2 was used as a probe to find out how well prepared the participants felt when they first entered the classroom as teachers and aligns with RQ3. Focus Group Questions 3 through 5 centered around the progression of the participants' efficacy for teaching science as they gain classroom experience and aligned with RQ1 and RQ2.

Data Analysis

Data analysis in a phenomenological study is focused on bracketing out one's own experiences. This analysis approach enables access to the participants' experiences when the researcher assumptions are bracketed (Moustakas, 1994). I employed the data analysis process prescribed by Moustakas (1994) which included implementing epoché, recording all relevant statements; listing each nonrepetitive, non-overlapping statement; relating and grouping invariant constituents into clustered meaning units and themes, synthesizing meaning units and themes into an experience texture description, reflecting upon my own textual description and description construction from my own experiences, constructing a textual-structural description of the meanings and essences of my experiences, and constructing a composite textual-structural description of meanings and essences of the experiences being studied. It was necessary that I clarified my personal consciousness through transcendental process before understanding that which was not my own (Moustakas, 1994). Synthesis was the final step of the research process as required by bracketing. Research synthesis embodies the central nature at that instance from the researcher's point of view. This only happens when the researcher has completely exhausted the practical and perceptive study of the phenomenon (Creswell, 2013b; Moustakas, 1994).

Bracketing is a kind of phenomenological reduction where the important parts of the research is set in brackets and all else is rejected (Moustakas, 1994). To bring out the fundamental nature of the phenomenon, bracketing must be the first step (Husserl, 1931; Moustakas, 1994). Bracketing makes it possible for the complete research process to be entrenched in the study topic and the research questions (Moustakas, 1994). Husserl found that by stripping away and abstaining from the knowing of things, the true essence could be considered (Moustakas, 1994).

In order to bracket out my own experiences during the interview process, I journaled throughout the process. Bracketing allowed the true essence to come through the data and the textural-structural description. This happened by setting aside my assumptions (Colaizzi, 1978; Streubert & Carpenter, 1999). I journaled my thoughts and opinions for each interview to ensure that I remained aware of and set aside my personal preconceptions and prejudices. By putting aside my preconceptions and prejudices, I was able to be receptive and true to the phenomenon (Colaizzi, 1978; Moustakas, 1994; Streubert & Carpenter, 1999).

Journaling allowed me to set aside any preconceptions and prejudices as a science teacher so that I was able to concentrate exclusively on the experiences of the participants (Moustakas, 1994). This was necessary to ensure leading prompts or questions would not happen during the interviews as well as in the horizonalization phase in data analysis.

The process of understanding that discovery possibilities, or horizons, are limitless is horizonalization (Moustakas, 1994). I "highlight [ed] significant statements, sentences, or quotes that provide an understanding of how the participants experienced the phenomenon" (Creswell, 1994, p.82). These horizons were sure to arise in my consciousness, yet it was "the grounding or condition of the phenomenon that gives it a distinctive character" (Moustakas, 1994, p. 95).

Upon completion of the interview transcripts, I reviewed the responses to find commonalities between the responses of the research participants. Fraenkel, Wallen, and Hyun (2012) described the commonality of perception as the "essence" or the essential structure of a phenomenon being studied (p. 432). I used an interactive inductive analysis which is an approach that uses a detailed reading of raw data to derive concepts and themes (Smith, Flowers, & Larkin, 2009; Thomas, 2006). The process of interactive inductive analysis allowed for nonlinear lines of thought and their creative assessment (Smith et al., 2009). Inductive analysis began with broad research questions so that themes, even those unexpected, emerged from analysis (Reid, Flowers, & Larkin, 2005).

After the data were collected, they were coded and combined. Then, structural and textural descriptions were created (Creswell, 2013a). The textural description depicts the participant's experience and the structural description of how they experienced the phenomenon based on the conditions, situations, and contexts (Creswell, 2013a). The descriptions take a cyclical path by beginning with the epoché and returning to the thing itself. There is a state of freedom during this process in which "every perception is granted equal value, nonrepetitive constituents of the experience are linked thematically, and a full description is derived" (Moustakas, 1994, p. 96). In this study, the experience description united the person, their conscious experience, and the phenomenon (Moustakas, 1994).

The essence of the phenomenon was revealed after creating textural and structural descriptions (Creswell, 2013a). The essence of the phenomenon is the basic, unchanging structure that centers on the common experiences of the participants (Creswell, 2013a). The essence reflects the participants' experience and, for this study, the perception of experiences of novice elementary teachers while teaching science (Moustakas, 1994). Sharing the experience let the participants' experiences be described in a way that the reader can better understand the phenomenology and to understand with it is like for someone to experience the phenomenon (Creswell, 2013b).

Trustworthiness

To ensure the trustworthiness of the study, several measures were used to address credibility, dependability, confirmability, and transferability (Creswell, 2013a). Addressing these four concerns allowed for the study to be deemed trustworthy. The four constructs have been created to respond to the need for alternative models appropriate for the qualitative design. This study utilized Creswell's (2013a) validation strategies to address the issues, to include triangulation; rich, thick descriptions; member checking, and peer review of data.

Credibility

The purpose of credibility is to ensure accurate descriptions of the individuals' experience of a common phenomenon (Krefting, 1991). Member checking was utilized to ensure credibility of the study (Moustakas, 1994; van Manen, 1990). Study participants reviewed and made corrections to the transcribed interviews, surveys, and discussion board summaries to ensure the collected data were accurate. According to Lincoln and Guba (1985), member checking is the "most critical technique for establishing credibility" (p. 314). Along with member checks, I used rich, thick descriptions so that other researchers can replicate my study to see if they obtain similar results. Using rich, thick descriptions provided more complete contexts for my study and allows the reader to comprehend the phenomenon completely.

Dependability and Confirmability

Dependability is an important requirement in qualitative studies because of the variable nature of the investigated phenomenon (C. Marshall & Rossman, 2014). Dependability in a study means that using the same research methods and participants would yield similar results (Lincoln & Guba, 1996). Smith et al. (2009) noted that research findings do not constitute a single definitive report, but do provide a credible report in qualitative studies. Dependability was ensured by the provision of supporting interpretations and the exploration of various perspectives in order to present a detailed, multifaceted description of the phenomenon (Reid et al., 2005).

An accurate interpretation of participants, excluding researcher bias, is referred to as confirmability (Lincoln & Guba, 1985). Researcher bias is inevitable, but Patton (2005) suggested researchers should focus on confirmability to ensure objectivity. Miles, Huberman, & Saldana (2013) suggest that researchers clarify predispositions. Gay, Mills, and Airasian (2012) warned that valid and unbiased data are almost impossible within a qualitative study. The interpretive role of the researcher makes bias and data invalidity a thoughtful concern. To preserve the integrity of this study, I clarified my biases and assumptions (Moustakas, 1994; van Manen, 1990). Clarifying my biases provided a statement of position as it relates to my personal beliefs relating to the topic and allowed me to recognize the items and events that have shaped my interpretation of the data (Rubin & Rubin, 2012; Stake, 2010). This technique also guaranteed that any preconceptions I may have held did not influence data interpretation. One method that I used was journaling throughout the study experience.

Triangulation, according to Schwandt (2007), is "checking the integrity of the inferences one draws" (p. 298). Triangulation of data utilized the three data collection methods to gather a complete perspective of the collected data. This triangulation allowed for the creation of rich categorization and theme development from the data.

An additional step to ensure trustworthiness was peer review (Lincoln & Guba, 1985). During the data analysis process, I consulted with other knowledgeable persons in the field of elementary science teaching to validate the conclusions. Peer review mandated that I be held to a high standard of data analysis because my peers would question the analyses as well as provide educational instructional expertise in drawing accurate conclusions. To reduce bias in the data collection process, triangulation of the data through the three data collection types as well as participants review of the interview transcripts ensured accuracy in the description of participant experiences.

Transferability

Transferability refers to the ability to apply research findings to other groups or settings (Creswell, 2013a). It also refers to the possibility that what was found in the context of the study can be applied to another context (Creswell, 2013a). To improve transferability, the results must be descriptive and interpretive in the extraction of superordinate themes. The in-depth, open-ended interview questions allowed me to dig deep into the lived experiences and provide thick, rich descriptions of those experiences (Creswell, 2013b). For the research to be used in other locations besides Georgia, transferability had to be ensured. To establish transferability, I used rich, thick descriptions to ensure abundant details about the participants, setting, and data (Creswell, 2013b). To improve transferability judgment by readers, participant demographic data were provided (Guba, 1981; Seidman, 2013), and a thick description was developed to describe each participant's experiences (Guba, 1981). Without these rich, thick descriptions of data derived themes, future researchers may not completely understand the data from this study.

Ethical Considerations

There was the possibility that ethical issues could arise in all phases of the research process (Creswell, 2013a). It was imperative that the participants fully knew the nature of the study while data were being collected and the analysis was conducted (Creswell, 2013b). It was imperative to create a strong sense of trust with the participants as well as the research sites to avoid any ethical issues that may have arisen. The following methods were utilized as ethical considerations: IRB approval as well as local permission with informed consent from the site and participants.

Even though the ethical risks of this study were minimal, there remained the risk of the loss of participant confidentiality. To limit the loss of participant confidentiality, pseudonyms were used, and care was taken to protect the participant identities because when utilizing the in-depth surveys and interviews, the identity of the participants may be unintentionally revealed or easily figured out due to the small size of the school settings. For this reason, anonymity could not be fully guaranteed in this study and study participants were adequately informed of this.

Informed consent forms, in addition to explaining the purpose of the study, informed the participants that anonymity could not be guaranteed due to the nature of the interview and questionnaire questions. Every possible effort was made to ensure confidentiality in all areas of data collection and the participants were informed of this.

Participants' interview transcripts, survey forms, and focus group discussion transcripts were kept in a confidential location and data were stored on a private, password-protected computer. Only the dissertation committee and I had access to the data. I ensured that all participants were treated kindly, with respect and honor.

Summary

This chapter was a presentation of the research design that was utilized in this qualitative study and outlined the steps that were taken to explore the experiences of novice elementary teachers as they teach science. The participants were purposefully chosen. Through exploring participants' experiences by analyzing interview transcripts, survey results, and focus group discussion notes, I described the phenomenon of the self-efficacy of novice elementary teachers when teaching science. These three forms of data allowed the information to be rich and triangulated to provide a more detailed description of the experiences. Throughout the process, participants were treated with respect, dignity, and care to ensure their comfort, ease, and feelings of value and appreciation. Finally, a careful analysis was completed to ensure participants' experiences were analyzed with accuracy, according to the participants.

CHAPTER FOUR: FINDINGS

Overview

As stated in Chapter One, the purpose of this study was to understand the perceptions of self-efficacy in science PCK for novice elementary school teachers at five elementary schools in central Georgia. The findings in this chapter include individual descriptions of each participant including gender, age, grade level taught, years of teaching experience, and educational summary. The coded data from the individual interviews, the focus group interview, and belief instrument are organized thematically, describe emergent themes related to each research question, and answer each research question. The chapter ends with a summary of the findings.

Participants

Eight females and four males participated in the study and are named through the use of pseudonyms for confidentiality. All of the participants completed a traditional teacher preparation program. Overall, the participants ranged in age from 22–28 years. Five teachers taught third grade, six taught fourth grade and three taught fifth grade. All of the teachers were responsible for teaching all subjects in the classroom. The total years of experience ranged from 0 to 4 years with each participant not having any specialized training or endorsement related to the science content. Table 1 shows the demographic information for each participant using his or her pseudonym.

Table 1

Participant Demographic Information

Name	Age	Grade	Experience
Anna	22	4	0 years
Benjamin	23	5	1 year
Claudia	23	3	1 year
Dan	22	3	0 years
Eve	24	4	2 years
Faith	23	3	1 year
Gabriel	25	5	3 years
Hannah	26	4	4 years
Isaac	24	4	2 years
Julia	25	3	3 years
Katherine	24	4	1 year
Leah	22	5	0 years

Anna

Anna is a fourth-grade teacher in her first year of teaching. She graduated from college in 2018 and was hired at a job fair held in the spring of the year she graduated. She completed her college's teacher preparation program and completed her student teaching in a district close to her college. Anna was an honor graduate in her high school graduation class and entered her college's honor program as an early admission freshman. Growing up, Anna felt that science "was challenging and unnecessarily difficult" and her science grades were lower than for her other academic classes. In her teaching preparation program, she was required to take one science course and she "went for the one that required the least amount of effort" which was environmental science studies.

Benjamin

Benjamin is a fifth-grade teacher in his second year of teaching. He is the current reigning Teacher of the Year for his school and district. Benjamin completed his student teaching in the same school in which he is currently employed. He classified himself as an "average student who basically slid through school until college" and his desire to teach arose from wanting to help male "students who looked like" him. An African American male, Benjamin is the first in his family to complete a college degree. He did not have much academic support or reinforcement as a young student and felt the need to be in a position to provide that for someone else. In his teacher preparation program, he had to take two science courses and he chose to take astronomy and entomology because of his fascination with Star Wars and his amazement with bugs. Benjamin performed well in his required science courses; he received an A in each class.

Claudia

At the time of the study, Claudia was in her second year of teaching. It is her first year in her current school as she moved after getting married last summer. Claudia knew she wanted to be a teacher for as long as she can remember. She fondly recalled playing school on her great-grandmother's back porch as a young girl and receiving a large chalkboard as a birthday gift when she turned 9 years old. She would use her younger siblings as her students and "force them to complete worksheets which were pages torn out of the TV Guide." Claudia possessed no adverse feelings toward science and actually enjoys science content. Her college's teacher preparation program required that she complete two science courses, one in life science and one in physical science. She enrolled in and completed classes in biology and chemistry. Claudia considers herself an above-average student and passed both of her science courses with an A average. She stated that she can "do science all day, but it is different when I have to break it down to a bunch of 8-year-olds." She struggles to convey the science topics she is supposed to teach to her students.

Dan

At the time of the study, Dan was in his first year of teaching third-grade after graduating from his college's teacher preparation program. He was a college athlete and was originally planning to major in exercise and sports science to prepare for a career in athletic training. It was not until he participated in a volunteer event at a local elementary school that he began to contemplate education as a career alternative. He changed his major to elementary education during his sophomore year in college. Since he had already completed science courses under his previous exercise and sports science major, he did not have to enroll in any additional science courses. He actually completed more science courses than the three required by his teacher preparation program. Dan considers himself an average student, but spent most of his time focusing on athletics and his grades were usually just enough to keep him academically eligible during his freshman year. After his freshman year, his grades improved and, by the time he entered the teacher education program, he had a 3.0 grade point average. His "focus on football was detrimental to academic health" in his freshman year and he had to work hard to improve his grades. He graduated from college with honors.

Eve

At the time of the study, Eve had 2 years of experience teaching fourth grade. She completed her college degree in the accelerated honors program and graduated with high honors before spending 2 years in Honduras doing Christian mission work. Upon returning, she was hired to work at the only school she applied to and began her teaching career. Because of her fluency in Spanish, she is able to serve the Hispanic student population well. She has many students who are of Hispanic origin and often she utilizes her bilingual skills in her classroom. Eve believes it was God's purpose for her to be an elementary teacher and she is passionate about her job. She knows that she "makes a difference every single day for the kids" and that is her joy. As a part of her degree requirements, Eve took three science courses which included earth science, principles of biology, and botany. The science classes were a part of her core requirements and she did not have any additional science content classes after entering the formal teacher preparation program.

Faith

At the time of the study, Faith was in her second year as a third-grade teacher. She completed her teacher preparation program at one of the largest colleges in Georgia and was a highly recruited applicant, receiving numerous job offers from multiple districts. She chose her current position because it is the same elementary school she attended. Her decision was "totally sentimental." She is now working with her former teachers. Faith has been commended on her teaching methods and has, in the short time she has been teaching, been commended numerous times for her classroom success. In her first year, her standardized test scores were at the top of the third-grade classes. She is a popular teacher in the school and spearheads much of the spirit activities as she was a cheerleader throughout her college career. Faith is energetic with a personality that fills up the room. Science was not one of Faith's favorite subjects and "it was never easy" for her. She had to work hard to earn above-average grades in the science classes she took. She was relieved that she only had to take two science classes to meet the requirements of her teacher preparation program. She enrolled in earth science and environmental issues to meet her science requirement. Even though she earned an A and a B in the classes, respectively, she had to devote much time and effort to do so. Faith referred to her situation as “science avoidance.”

Gabriel

At the time of the study, Gabriel was in his third year of teaching fifth grade and is the only male faculty member in his school. As the only male faculty member, he is the “unofficial handler of all boy issues.” When there are issues related to the male students, he is the one that is tapped to be the mediator. He is a self-proclaimed “country boy” who loves to go to the local rodeo on the weekends and go out to the river mud-bogging after a rainstorm. He recently became engaged to his college girlfriend and they are planning a winter wedding. Gabriel attended an agricultural, land-grant university on an academic scholarship. He changed his major after his sophomore year to elementary education. He entered college with plans to teach at the middle school level, but soon realized that he was drawn to the younger ages. In his teacher preparation program, he was required to take two basic science courses. Gabriel was able to transfer two science courses—chemistry and anatomy—he took as a dual-enrolled student in high school and did not have to take any science classes on his college campus as he was not a science-based major.

Hannah

Hannah decided to become a teacher early in life as she wanted to follow in her mother’s steps as an elementary school teacher. At the time of the study, she was in her fourth year of teaching fourth grade. Her mother teaches third grade in the adjoining hall and they commute to work every day as they are roommates in a newly renovated farmhouse. Hannah is 26 years old. She attended a local community college and was in the first cohort of the newly added 4-year degree program for elementary education. Her teacher preparation program did not require any science content courses and she described herself as “jumping for joy because science had not been nice” to her. She struggled in science in middle and high school and even had to attend summer school once to makeup a science class she failed. An admitted “right-brainer,” Hannah prefers the “liberal arts to anything that may be anywhere close to analytic.” She reads new books every month or so and takes painting and pottery classes during her downtime.

Isaac

As a teenager, Isaac made the decision that he wanted to be a coach because he loved sports and wanted to emulate his former coaches. Growing up without a father-figure, he struggled with feelings of loss and always felt that he was missing out on something. As he aged, he found what he was missing in his coaches and knew that he wanted to play that same role for other children like him someday. He spends his free-time attending other sporting events and working as a referee for recreational sports. At the time of the study, Isaac, a fourth-grade teacher, had 2 years of teaching experience and was a member of the football coaching staff of the district’s only high school. He completed the teacher preparation program of his university and was hired before he finished his student teaching practicum. He was only required to take one lower level science class and he chose geology because “it was offered as a morning class and was supposed to be easy.” Isaac considers himself an average student, “but did not make any special efforts to excel” and ultimately “flew under the radar.”

Julia

At the time of the study, Julia had 3 years of experience teaching third grade and is a self-proclaimed “science geek.” She loves science and is intrigued by the content. She regularly participated in science activities when she was in middle and high school. She was a member of the Science Olympiad team for her school, which required that the students participate in science-based academic competitions. Julia believes that if she had not decided to become a teacher she would be in a science-related career. However, teaching was "in the center of her heart" and that is what she chose as her major. She attended a major state university and declared elementary education as her major. In order to complete her degree, Julia had to complete two basic science classes and one science methods class. She said that her science methods course was just the basic content delivery and utilized outdated state standards as references. Julia enrolled in Biology 1101 and Biology 1102 to complete the science requirements for her degree. She received excellent grades in both courses and enjoyed the classes just as she did as a younger student. Julia was hired at the first school she applied to and is still employed at the same school.

Katherine

Katherine was a senior in high school when she became pregnant with her daughter Kailey. She gave birth the week before graduation and immediately went to work to support her daughter. She received public assistance but "did not want to depend on anyone else or the government to take care of" her family. For this reason, Katherine knew she needed to take extra steps to ensure she could independently care for herself and her daughter. She worked two full-time jobs for 3 years in order to save money for college and take care of her daughter. One of her jobs was as a paraprofessional in her local district's elementary school. By the time Kailey was old enough to go to Head Start, Katherine begin applying to community colleges. She had to continue working, but took evening and online classes and completed her degree in 3 years. Science was not a part of the core requirements at her college, but she was required to take one course in science methods. She completed her practicum at the same school where she was employed as a paraprofessional and was eventually offered a job at the same school. At the time of the study, she was completing her second year of teaching.

Leah

At the time of the study, Leah was a first-year teacher, living her life-long dream of working with children. She had worked part-time at a daycare center since she was 16 years old and knew she had found her life's calling. She "found great joy in working with the kids" and began her journey as an educator. Leah is the only child of parents who are also educators. Her father is a middle school teacher and coach and her mother is the high school media specialist. Living in a household with educators, she was able to "witness all of the good, bad, and ugly of education." With her parents' guidance, Leah was well aware of what to expect both in college and throughout her preparation program. As required by her academic program, she had to complete two science classes and a methods class once she was accepted into the education program. An outstanding student, she graduated with high honors and had multiple job offers. She decided to accept a job in a district next to the town in which she resided. She did not want to work in the same district where she lived because she saw some of the things her parents had to endure by working and living in the same district. Leah has had a pleasurable experience teaching and would love to retire from the profession in 30 years. At the time of the interview, she was teaching fifth grade, but preparing to change to third grade for the next school year.

Results

Data from the individual interviews, focus group interviews, and belief instrument (STEBI-A) were coded for recurring themes. From the data analysis, three major themes and seven subthemes were determined and are represented in Table 2, in addition to the frequency of each code. The three major themes were (a) teaching methods, (b) teacher preparation, and (c) student impact. The themes for this study were developed using the phenomenological design for data analysis. Data were gathered using three methods to include individual interview, completion of the STEBI-A, and a focus group interview of novice third through fifth grade teachers at public elementary schools in central Georgia districts. Codes were developed through the use of bracketing, horizonalization, and clustering of themes using the ATLAS.ti coding program. This development was derived and modeled from Moustakas's (1994) method for data analysis modified from van Kaam's (1959) method of analysis. The research questions were answered through the themes and subthemes resulting from the data analysis.

Table 2

Themes

Subtheme	Code
Teaching methods	
Lack of content knowledge	Unprepared (19)
	Totally lost (8)
	Very uninformed (4)
	Had no idea what I was teaching (3)
	Didn't know what I was doing (2)
	Felt dumb (1)
Negative emotions	Failure (18)
	Overwhelmed (12)
	Defeated (9)
	Apprehensive (7)
	Felt intimidated (5)
	Isolated (4)
	Feeling stupid (3)
Instruction	Lack of resources (17)
	Box curriculum (4)

(continued)

Table 2 (continued)

Subtheme	Code
Teacher preparation	
Negative emotions	Not enough science (21)
	Inadequate (17)
	Useless (14)
	No references (11)
	Unrealistic (9)
	No purposeful training (1)
Positive emotions	Help (13)
	Encouragement (13)
	Getting better (12)
	Assistance (12)
	Improvement (8)
	I can do this (1)
Student impact	
Academic outcomes	Grades (15)
	Parent issues (10)
	Fail (3)
Classroom environment	Avoidance (16)
	Fun (10)
	Skip it (4)

Theme 1: Teaching Methods

Teaching methods can be understood as the means teachers take to instruct their students in the various content areas. These methods impact the way students take in and eventually process the content knowledge. Teaching methods are a direct result of the teacher's grasp of the content. Teachers who are comfortable and assured of their level of content knowledge are able to integrate innovated and creative teaching methods which are suggested to make the learning experience productive for the students.

Teaching methods was the first theme that arose from the data analysis. Through data analysis, the subthemes of lack of content knowledge, negative emotions, and instruction arose. Participants shared their frustration and disappointment in their experience with teaching elementary science. Participants described their experiences in the classroom where they were ill-prepared for the task of teaching science at the elementary level.

Lack of content knowledge. During data analysis, the first subtheme to emerge from the major theme of teaching methods was lack of content knowledge. Many participants expressed negative emotions toward the situations they have encountered in their classroom. In the 12 interviews, the word *unprepared* was mentioned 19 times. The participants shared their feelings of being unprepared to teach the science content. Eve stated, "I was blindsided with the content. I was wholly unprepared for the task at hand." Isaac shared, "Unprepared was, like, the nice way of saying what I was. I had no idea of what I was supposed to be teaching." Faith added, "I never felt so unprepared in my entire life. I had to go to the other grade level teachers to help me."

The participants expressed various levels of preparedness, with all of them expressing they were on the incorrect end of the continuum. Leah stated, "I was totally lost when I started. I didn't know what seemed like anything and I felt so inadequate." Benjamin expressed a similar sentiment: "I felt so dumb. I mean, I knew I wasn't, but I was not prepared to teach this class." Hannah said that she "felt like I was walking into the classroom with a set of blinders and then having somebody knock me across the face with a brick. I didn't know what I was doing at all."

The lack of content knowledge was a blow to the confidence the participants had in their teaching methods. Anna remarked, "I didn't even want to deal with science. I would purposefully draw out other lessons so that we wouldn't have time for science. I was tired of feeling stupid and lost." Benjamin commented, "It was my worst time of the day and I was actually nervous when it was time for my science block." Gabriel questioned his career choice because he felt he lacked the content knowledge he needed: "I seriously considered moving to the middle school level so that I wouldn't have to be bothered with the science content. I could teach one subject in middle grades."

Negative emotions. The second subtheme to arise from the major theme of teaching methods was negative emotions. Participants expressed their negative feelings about their teaching methods. The emotions noted by the participants ranged from feelings of intimidation to emotions so severe that they actually manifested in physical sickness. As a part of this subtheme, the term *failure* was used a total of 18 times. During Julia's interview, when describing her emotions, she had tears in her eyes. She was overcome with emotion and expressed her negative emotions by saying "I felt like a failure. I had this degree and passed the [certification test] but I was so overwhelmed with science." Anna had similar sentiments: "It was like I was defeated every time it was time for science. I would get sick to my stomach sometimes because I wasn't comfortable with the content." Leah stated, "I was so apprehensive when it came to science. I was scared of doing something wrong and messing up the kids' education."

In addition to the word *failure*, the word *overwhelmed* was used a total of 12 times in the various interviews. Dan said,

> I spent my entire life trying to overcome the stereotype of the dumb jock, but here I was feeling just like that. It made me mad and I was defeated. I don't like to lose anything and I felt overwhelmed and lost.

Katherine had feelings of being overwhelmed as well: "I felt awful. I was overwhelmed and embarrassed to ask for help because I thought this was something I should've known. I isolated myself because I didn't think I was good enough. It totally messed with my self-esteem."

Instruction. Content knowledge is connected to instruction. An additional subtheme to arise from the data analysis was instruction. Participants were concerned that their instruction was not up to par because of their insecurity with the science content. According to Faith, "I know how to teach. I know all of the pedagogy, but I just didn't know what to teach with science. I didn't know how to pull it together." Gabriel was concerned with the quality of instruction as well: "I had no resources to help and I am always afraid that I don't have what I need to do what I need to do when I teach [science]."

The majority of the participants questioned their effectiveness for instruction. They did not feel that they were teaching science at the level the students needed to learn and comprehend. Isaac said, "I didn't want to be the reason my kids didn't know science, but I was stuck." Leah's sentiment was similar to Isaac's: "My fear was that my instructional methods were inadequate and my students would not learn what they needed to be successful."

Some of the study participants used prepackaged curriculum sets in their classrooms to teach science, but it did not increase their confidence. Four of the participants had access to the curriculum sets, but each of them expressed frustration with its contents. Katherine commented, "I have the box curriculum, but it doesn't help me feel any better about what I'm giving my students. I would feel so much better if I had something more." Claudia continued, "That box curriculum just had worksheets and activities, but it didn't help with being able to explain stuff if the students asked me questions. That was the scariest part."

The other participants did not have prepackaged curriculum sets and were left on their own to develop instructional methods to match the science standards for their grade levels. Anna spoke of her frustration: "I didn't have anything to teach with; nothing to guide me. I lacked the resources to properly instruct my students." Many of the other participants echoed Anna's remarks. Faith said, "The lack of resources was awful. I had to search the Internet for things. I found things I wanted to do, but much of it was not explained well enough for me to use." Gabriel continued,

> I was spending more time trying to find things to help me teach science than I was actually teaching science. I had to spend hours each week for a 20-minute science lesson just to try to make up for the lack of teaching resources.

Theme 2: Teacher Preparation

Most elementary school teachers enter the profession after completing a traditional teacher preparation program. Teacher preparation programs require different courses depending on the institution. The second theme that emerged from the data analysis was teacher preparation. Through data analysis, negative emotions and positive emotions arose as subthemes. The participants had both positive and negative feelings about their teacher preparation programs.

Negative emotions. There were more negative comments on the teacher preparation programs and the phrase "not enough science" or some version was mentioned 21 times. Many of the participants expressed their enjoyment of their college experience and their overall teacher preparation program, but were disappointed by the lack of preparation for science. Science was not an integral part of many of the teacher preparation programs that the study participants completed.

Eve spoke of her preparation program saying, “I didn’t have to take a methodology class for science. We weren’t taught how to teach science. There was not enough science.” Eve, like other study participants, had to take science courses to complete the degree program, but did not have to take a methodology course for science. Faith said, “I was happy at the time that I didn’t have to do any more science, but now it’s hurting me. I wish I could have a do-over because what I got was really inadequate and useless.” Anna echoed Faith’s comment: “I thought I was getting off easy, but now I am struggling because I didn’t get the science. We had no purposeful training for science.”

Katherine was one of the few study participants who were required to take a science methodology course. She said that the course was helpful, but it was focused on lower level grades. Katherine said, “We had some good information, but it was targeted for primary grades. Plus, the standards changed the year I entered the classroom, so I was still lost and had no purposeful training to help me.” Isaac felt he did not need any more science:

> I thought it couldn’t be hard. I mean, it’s just elementary science. I’ve done all of that, graduated high school and college. I never thought I would be lost in an elementary science class but what I had was unrealistic.

Faith commented, “The bad part about it was that I had no references or resources to go back to. I had things I could use for the other content areas but nothing at all for science.”

Positive emotions. To counteract the negative comments, there were positive emotions expressed by the participants regarding their teacher preparation programs. Even if the participants did not feel that they were sufficiently prepared to teach the science content, they expressed positive sentiments for their program and professors. Claudia expressed her approval of her program: "I wouldn't trade my experience because I know I can always go back to any of my professors for help. They wouldn't let me fail." Leah said, "I had all of the help and encouragement that I needed in my program. Of course, I feel that I needed more science, but my prep program was great."

Hannah was equally pleased with her program overall: "I had some of the best times of my life while enrolled in the program. They were making changes while I was there and the program was getting better." Isaac also said, "I emailed one of my old professors for some assistance with some stuff and she send me a boatload of resources to help me. I know they have a prescribed program, but I know they're working to improve." Hannah added,

> I had a similar [experience]. I was almost in a complete panic attack and contacted my former advisor. Once I got off the phone, I was feeling like yeah, I can do this. It may not have been every single thing that I needed, but it gave me something I needed more, which was reassurance.

Leah continued,

> I would never slam my program because it was a great program. Are there things I would change if I could? Of course; but I had a great preparation program at [my college] and I wouldn't trade that experience for anything.

Theme 3: Student Impact

The third theme to emerge from the data analysis was student impact. Through data analysis, the subthemes of academic outcomes and classroom environment emerged. Participants shared their challenges for student achievement.

Academic outcomes. During data analysis, the first subtheme to emerge from the major theme of student impact was academic outcomes. Several participants expressed issues related to student achievement and academic outcomes. Gabriel stated, “I was concerned that what I didn’t know would impact my students’ grades. I didn’t want my kids to fail because I wasn’t sure of science.” Dan felt that he was responsible for his students’ lack of science comprehension: “When they didn’t do well or understand something, I felt like it was my fault because I couldn’t explain it better.” Anna echoed Dan’s comments: “I felt that I wasn’t worthy, I guess, to assign grades for what I felt that I didn’t teach well enough. I usually just gave my students grades based on completion.”

In addition to student grades, parent issues were also a common experience of the study participants. Eve stated, “I had a parent conference once and we had to discuss an issue with the student’s grade in science. She basically told me that I wasn’t teaching the child.” Benjamin also responded, “I didn’t feel confident when I talked to parents about science. I tried to avoid it at all costs.” Leah said, “I am always afraid that science is going to come up. I try to make sure I steer clear of that becoming a topic when I have to conference with parents.” Isaac was not comfortable in having parents come to visit his room during the school STEM night: “I was picked to host the science portion, and panic set in. I didn’t want to look like a failure so I called the high school to send someone over to lead it.”

Hannah expressed to concern that she would cause permanent damage to her students’ academic career in science because “the kids would fail science and it would be my fault.” Katherine expressed similar thoughts:

> I just knew that I would be the cause of my students failing in their middle and high school science classes because they did not receive the foundation they needed to do well. I felt bad for the middle and high school teachers.

Isaac lamented, “I did the best I could, but I know it wasn’t even close to what my kids needed. I just hope I didn’t make anything harder for them in the future.”

Classroom environment. The second subtheme to emerge from the major theme of student impact was classroom environment. Many of the study participants concerned themselves overwhelmingly with the notion that their classroom environment was insufficient to meet the needs of their students. Julia said,

> I am one of those teachers who takes notions from Pinterest and all. I would look at the way those teachers had their rooms set up for science and how they did the science lessons and I just had no idea on how to get there.

Faith said,

> I wanted to be the best possible teacher I could be, but my go-to was just to avoid science. I fill my days with other parts of the curriculum and save science for last, hoping we would run out of time.

Hannah stated, “Science is definitely last on my to do list every day. We only have 20 minutes for science, but I tried to avoid those 20 minutes with everything inside of me.”

Even though many of the study participants tried to avoid science, a few of them expressed satisfaction when they tried science activities that worked. Anna said,

> I happened to find some simple activities on Teachers Pay Teachers and they were explained really well. My students had so much fun during those times. I would love to do that every day, but there are only so many lessons that offer deep explanations.

Isaac said,

> After I had the high school people come over for our STEM night, I recreated the activity of making a tornado in a soda bottle. The kids were so amazed and had so much fun. I just wish I felt comfortable doing stuff like that all the time.

Some of the participants chose to just skip pure science topics all together. Claudia said, “I know it sounds bad, but my kids were not being tested on science, so I didn’t worry about it much. I did what I could and just let it go.”

Research Question Responses

This study was guided by three research questions addressing participants’ lived experience as novice elementary science teachers. The research questions were grounded in Bandura’s (1997) theory of self-efficacy and Shulman’s (1986) theory of PCK.

RQ1

With RQ1, I sought to understand how the novice teachers perceive their self-efficacy in teaching science. The participants provided descriptions that allowed for the development of three themes (i.e., teaching methods, teacher preparation, and student impact), which all helped to describe participants’ perceptions of their past lived experiences of self-efficacy while teaching elementary science as a novice teacher. Also, seven subthemes were developed that further narrated the participants’ experiences with science education as a novice teacher at the elementary level. Participants explained the difficulties as well as the victories they experienced. Faith was especially expressive about her frustration with teaching science:

> I felt like I was stuck in quicksand. It felt like I was trapped in ignorance, but I was the one who was supposed to bring others out of ignorance. I was supposed to lead and here I was feeling defeated and downtrodden.

Isaac rejoiced in his small victories of successful science lessons:

> When I had a good lesson and could answer the students' questions, it felt like I had just coached my team to a championship win. I know that may sound silly, but when you've struggled with something like I have, it's the small things that can mean so much.

RQ2

With RQ2, I sought to understand how the novice teachers perceive their self-efficacy in science content knowledge. The participants expressed their perceptions of their lived experiences, which led to the development of overarching themes related to their perceived lack of science content knowledge. The overarching theme with science content knowledge was the participants' feeling of unpreparedness and a lack of science content knowledge. Eve said, "I just don't know the science that I need to know. I couldn't teach my students what I didn't know." Faith stated, "Science was never one of my favorite subjects so I just did enough to get by. Well, now I can't just get by anymore and I don't know enough to fake it." Katherine said,

> I didn't have to take any science in college, so the last time I really had science was when I was in high school and that was almost 10 years ago. I was not versed enough in science to teach it. I have been working so hard to make sure my students get the education they deserve, including the science content.

RQ3

With RQ3, I sought to understand the participants' perceptions of their preparedness for teaching science after completing a preservice teacher preparation program. The participants conveyed their overarching unpreparedness to teach science. The majority of the research participants expressed their satisfaction with their teacher preparation program, but did note the lack of preparation in the science content area. A few of the participants were especially defensive of their respective programs, but did consent that there was a large area to improve in the science area. Benjamin was an especially staunch support of his program, "It was what I needed to get a job and make an honest living. No program is perfect, but mine was about as good as you're going to find." Leah was also supportive of her program, but did acknowledge that there could be improvements made:

> I can't sugarcoat it. I love my school and the [college of education], but if I was able to, I would revamp some parts of the program. Now, that doesn't mean to say that I am disappointed in the program but as an old teacher once told me, if better is possible, good is not enough.

Summary

The purpose of this study was to understand the perceptions of self-efficacy in science PCK for novice elementary school teachers at five elementary schools in central Georgia. Chapter Four included a description of novice elementary teachers' lived experience of teaching science content in Georgia. The data were gathered from 12 participants who completed individual interviews, the STEBI-A, and a focus group interview. The major themes and subthemes developed during data analysis supported information collected during this research. Through data analysis based upon Moustakas's (1994) recommendations for phenomenological data analysis, three major themes emerged: teaching methods, teacher preparation, and student impact.

CHAPTER FIVE: CONCLUSION

Overview

The purpose of this transcendental phenomenological study was to describe and understand the perceptions of the lived experiences of novice elementary teachers when teaching science in central Georgia. Individual interviews, a focus group interview, and the STEBI-A were used to explore participants' experiences. Three themes and seven subthemes related to the 12 participants' experiences as elementary teachers of science were identified during data collection and analysis. The results of this study revealed that elementary science teachers lacked self-efficacy for teaching science content at the elementary level. This lack of self-efficacy is due to the limited amount of content knowledge, substandard preparation programs in elementary science, and teaching environments that do not support growth in the area of science teaching. Participants described a range of mental and emotional responses to the frustration and distress they perceived as their lived experiences as teachers. Chapter Five includes a summary of the study findings, a discussion of the research implications, acknowledgement of the delimitations and limitations of the study, and recommendations for future research.

Summary of Findings

The study included data from individual interviews, a focus group interview, and results of the STEBI-A. Participants included 12 novice elementary school teachers who had 4 or less years of experience as an elementary teacher in central Georgia. The major themes of this study were teaching methods, teacher preparation, and student impact.

The central research question guiding this study was used to understand how participants perceived their self-efficacy for teaching science at the elementary level. Three major themes were identified through the exploration of RQ1: teaching methods, teacher preparation, and student impact. Throughout data collection, participants described how they experienced negative emotions associated with teaching science content at the elementary level. Anna stated, "I would literally break out in hives when I had to do science. I was terrified of not doing the right thing." The novice teachers identified lack of content knowledge and instructional deficiencies as the sources of their professional struggles. Gabriel said, "I can teach what I know but I don't know enough of this science. If I knew it, then I could teach it to my kids." They described feeling inadequate, unprepared, overwhelmed, intimidated, and isolated. Leah summed up the sentiments of many of the participants:

> I wasn't ready for what was thrown at me with science. I was totally unprepared for this and I felt like I was the only one. I was afraid to ask anyone else because I didn't want to seem unprepared, inadequate, or unqualified for the job. Perception and reputation are everything in the education field.

The negative emotions experienced by the participants cast a dark cloud over what they perceived to be a profession of accomplishment and joy. Katherine stated, "I want so bad to be a good teacher, but I feel that I can't reach that goal because of my struggles in science."

RQ2 was used to understand how participants perceived their self-efficacy in science content knowledge. The majority of the study participants expressed a severe lack of confidence in their science content knowledge. Isaac stated, "I didn't know what I was supposed to be teaching. I would read the standard and then have to Google it. I had absolutely no confidence in my ability to teach science." The participants expressed negative feelings associated with science content knowledge and did not feel that their level of PCK was sufficient to be an effective science instructor. Hannah stated, "I didn't know enough to teach it. I've always heard that if you can't explain it to someone, then you don't know it. Well, I definitely didn't know it because I couldn't explain it at all." Not having a deep understanding of the science content led to feelings of defeat and failure. Faith said, "I felt so bad when it came to science. I am the perky, happy one in the building, but not when it came to teaching science. I felt like a complete failure because of it."

RQ3 was used to understand how the participants perceived their preparedness for teaching science after completing a traditional teacher preparation program. While the participants praised the overall quality of their teacher preparation programs, they lamented on the lack of science concentration. Leah stated, "My program was good, but if there was one thing I could change, it would be to add more science into the requirements. I needed more of it even though it's a small portion of my grade-level content." Only three study participants were required to complete a science methods course as a part of the teacher preparation program. The most common complaint was that the preparation programs did not have enough science content. Julia stated,

> I know that I'm one of a few of us who had science methods but it still wasn't enough. We should have had multiple science methods courses, like one for life sciences and one for physical sciences. Everything was jumbled altogether in one methods course and it felt like we were just touching on a few concepts and not everything.

All of the participants referred to their teacher preparation program, in regard to science, as inadequate.

Discussion

The purpose of this transcendental phenomenological study was to describe and understand novice elementary teachers' perceptions of their lived experiences with self-efficacy for teaching science. The findings of this study provide support of the theoretical and empirical literature presented in Chapter Two; that participants had negative experiences due to the lack of self-efficacy when teaching science at the elementary level. The lack of self-efficacy arose from the lack of PCK in science. The results of the study are supported by Bandura's (1997) theory of self-efficacy and Shulman's (1999) theory of PCK.

Theoretical Literature

One theoretical framework guiding this study was Bandura's (1977, 1978, 1997) theory of self-efficacy. Novice teachers are prone to feelings of insecurity and doubt, but quickly overcome these feelings after encountering mastery experiences (Bandura, 1997). Mastery experiences are those in which the teachers are reassured of their skills and abilities and therefore increase self-efficacy. Those mastery experiences reinforce the self-efficacy of the teachers and provide the impetus to tackle additional tasks. The research participants in this study had few, if any, mastery experiences and hence did not have an increase in self-efficacy. The participants discussed their experiences of self-efficacy by describing feelings of frustration, decreased sense of accomplishment, and failure.

The novice elementary teachers discussed spending countless hours preparing to teach 20-minute science lessons with little to no success. Anna, Dan, Hannah, Julia, and Katherine all shared their frustration of spending so much time on such a small part of their teaching day. Anna stated, "I would work after school and then at home to try to get things together for my science lessons. I felt like I was just spinning my wheels." Hannah shared, "I spend so much time on science, that my math and reading lessons were beginning to suffer. We only test math and reading so I had to begin to think long and hard about my efforts." Dan added, "I was totally consumed by the science and began to neglect the other content. That wasn't good for my kids."

A decreased sense of accomplishment was another facet of the lack of self-efficacy experienced by the research participants. Benjamin, Claudia, and Faith expressed their disappointment when their efforts seemed all for naught. Claudia said, “I was doing all this work and I couldn’t see improvement. I still felt like a failure.” In order for there to be positive self-efficacy, teachers must have positive reinforcement of success (Riggs & Enochs, 1990).

The second theoretical framework guiding this study was Shulman’s (1986) theory of PCK. PCK is distinctive to teaching and is the basic essence of teaching. It is the means by which teachers relate what they know to those they are teaching (Shulman, 1986). Based upon the theme that teaching requires understanding, PCK is required for teachers to give meaningful, relatable, and lasting instruction. Shulman (1986) encouraged two types of knowledge that teachers must have in order to be effective. Those two are content knowledge and curriculum development knowledge. The participants in the current study expressed the lack of both content knowledge and curriculum development knowledge.

The study participants expressed their lack of understanding science content. Faith stated,

> I had a hard time with science when I was in school. Now, I’m expected to teach something that I struggled with and still don’t fully comprehend. I can tell the kids what I read from a book, but I can’t elaborate or answer their questions. I have gotten tired of saying “Let me check on that and I will answer it tomorrow.”

Many other participants echoed the same sentiment expressed by Faith. Benjamin said, “The science classes I took had nothing to do with the standards I’m expected to teach now. I haven’t seen some of the content since I was in elementary school.” The overall consensus among the participants is that they did not know the science content well enough to teach it.

In addition to not knowing the content, the study participants were not familiar with the design of the science curriculum. They were not able to put the curriculum puzzle pieces together to make sense. Hannah stated,

> I didn't know how the curriculum was designed, like how it grows from grade to grade. If I knew that I could know better how to present the content to my kids because I would know what they needed to do well in the next grade.

Gabriel added, "The standards were pretty straightforward, but I couldn't make sense of the progression. I guess if I had a better understanding of the content, then the curriculum progression would have made more sense." Julia concluded,

> I thought myself to be pretty okay with science, but in my methods class, we really didn't look at curriculum from grade to grade. I'm still pretty lost when it comes to what the students are supposed to gain each year in science. I am really in the dark about middle and high school science.

Empirical Literature

The information presented in Chapter Two was largely supported by participants' experiences of self-efficacy and PCK. Participants described experiences of apprehension, defeat, unpreparedness, and failure as they attempted to teach science at the elementary level. Participants' responses to their lack of self-efficacy mirrored the research presented in Chapter Two. This section explains how the results of this study support or diverge from previous research about novice teacher self-efficacy.

The results of this study support previous research that suggests the lack of PCK creates lower self-efficacy of novice elementary science teachers (Herman & Clough, 2016). The participants all expressed the feeling of defeat and failure when attempting to teach science to their elementary students. They took their perceived failure to heart and created a sense of guilt for not being able to properly educate their students in the science content. The participants expressed a willingness to learn the science content to be able to deliver it to their students in a way that they could properly learn the content. Eva stated, “I am glad there isn’t a science test for the elementary grades. I’m afraid my students wouldn’t do well.” Eva continued, “I don’t mind doing extra work or classes to get better because I am not confident in my ability now.” This further affirms previous research suggesting that the lack of PCK is associated with the lack of self-efficacy (Tosun, 2000b).

Similar to the studies presented in Chapter Two on self-efficacy, participants in this study shared experiences in their elementary teacher preparation programs. The participants who were enrolled in programs that required a science methods course echoed previous research. Palmér (2016) showed methods courses increased teacher self-efficacy. Julia, Katherine, and Leah each expressed a willingness to engage in more hands-on activities with science. Julia said, “I had activities from my methods class that I could use in my classroom. It made a difference.” Katherine expressed her raised level of confidence because she had the experience of the methods course: “Even though I didn’t have examples of all of the topics, I had enough to stretch out and make it seem like I understood what I was doing.” Leah reiterated their comments by adding, “I can’t imagine not having the stuff I did from methods. I would have been totally lost without it.”

Even though the methods courses provided activities for the prospective teachers to incorporate into their lessons, the course did not close the knowledge gaps of those who were required to take the class. Research by Hagevik et al. (2015) was supported by the results of this study. The participants in this study expressed their continued lack of comprehension of the science content even after completing the methods course. Leah said, "They gave us activities, but didn't help us understand the content. It would've helped if we went through the standards for each grade and worked through them learning the content and adding teaching methods to that."

Implications

Current and future teachers, administrators, teacher preparatory program providers, and other stakeholders in the education community can use the information provided in this study to aid in understanding and improving experiences of novice elementary teachers. Additionally, this information may make stakeholders aware of areas in which they can support teachers in increasing self-efficacy for teaching science. This information adds value to the body of work that informs about teacher self-efficacy, thus supporting efforts for teacher retention.

Theoretical Implications

Self-efficacy is essential in teaching. The lack of PCK decreases teacher self-efficacy (Ozden, 2008). Participants expressed their lack of comprehension of the science they were tasked with teaching. Leah stated,

> How am I supposed to teach something that I know nothing about? Yes, I could go home and read it and retell it to my students the next day, but if a kid asked a question, I was in deep [trouble].

The majority of the study participants expressed their anxiety and apprehension when students approached them with questions related to the science content.

This research adds to the existing body of literature surrounding the application of self-efficacy to novice elementary educators. In this study, self-efficacy was explored through the lived experiences of novice elementary teachers as they teach science. Participants expressed a lack of confidence when teaching science and it would be naïve for anyone to think that it had no lasting impact upon their pupils.

The participants in this study reported that they lacked the confidence to teach elementary science at a level that would be beneficial for the students. They did not trust their abilities in teaching science. Elementary science teachers should leave their teacher preparation programs with a high confidence in all content areas. Self-efficacy is at the core of a successful teacher and should be a major part in the creation of new teachers.

Teachers should know exactly what they will teach as well as how they will teach it. PCK was lacking in the study participants. Most of the participants had limited knowledge of the science content they were tasked to teach. Anna said, "I didn't like or understand science when I was in school. I still don't understand it. How am I supposed to teach it?" The same feeling was expressed by Isaac: "In school, I just did enough to get by. I didn't do it back then and now I'm expected to teach it with no guidance or experience. I feel like I've been set up for failure." Hannah continued the conversation by saying,

> Science has never been my thing. I avoided it at all costs. I didn't have much experience with it at all and now I have 26 children who depend on me to teach it to them. I don't want to harm them by not being able to teach them the way they deserve to be taught.

The participants expressed the need for teacher preparation programs to focus more on science PCK. All of them said they should have had more science throughout their program to have more success in the classroom as a novice teacher.

Empirical Implications

Although there is a large body of literature that reflects teachers' experiences of self-efficacy, qualitative studies utilizing novice elementary teachers in the science content has not been readily available. Studies of teacher self-efficacy have often been quantitative studies that did not incorporate the perceptions of the teachers. The present study fills a gap in the research literature, as the participants represent a unique population in a region that has been often overlooked. Further, having qualitative data from interviews and STEBI-A responses provided by this population of novice elementary teachers fills a gap in the literature.

Interviewing teachers who have less than 5 years of teaching experience gave educational perspectives from a neglected population. The collection of data from the 12 participants in this study, along with previous research, showed that the lack of self-efficacy as a result of the lack of PCK in science has a negative effect on teacher enthusiasm and self-perception (Fine et al., 2013; Holzberger et al., 2013; Marsh & Seaton, 2013). Faith lamented on her discouragement for teaching science: “I had no success and I gave up. This is not what I signed up for.” Faith eventually began to doubt her overall effectiveness as a teacher because of her lack of success in teaching science. Like Faith, Eve, Isaac, and Julia expressed their feelings of defeat and decreased self-perception. Eve admitted that she even considered leaving the teaching profession because she “felt a gut-punch every time I had to teach science.” Eve went on to say that she also doubted her professional choices at times because she felt like she was doing her students “no good at all.”

Educational authorities, such as teacher preparation program coordinators, deans of education schools within colleges and universities, administrators, and superintendents should consider an alternative approach to the way science is both taught to prospective teachers and how science content knowledge is reinforced through job-embedded professional development. This would support teachers in maintaining positive self-efficacy perceptions and improve teacher morale (Mojavezi & Tamiz, 2012; Ramey-Gassert & Shroyer, 1992). Participants in this study expressed dissatisfaction with professional development opportunities and resources from their schools and districts. Julia stated,

> They wanted us to do all of these hands-on activities and inquiry-based experiments, but didn't give us the first hint on how to do it. They told us to do it, but didn't tell us how to implement something like that.

The research participants expressed disappointment that they were not given what they seemed so desperately to need. Isaac said, "I went to everyone . . . even emailed the superintendent and he sent me some Google links. I could have done that myself." Julia continued, "Every time we were asked what we would like to have added to the professional learning agenda, I would mention science-related items, but it never was added." Many of the participants felt that their pleas for help were not being heard or acknowledged.

Practical Implications

This study provided practical implications for all stakeholders associated with education in K–12 education. Professional support is a predictor of teacher success (Ramey-Gassert et al., 1996; Riggs & Enochs, 1990; Tschannen-Moran & Hoy, 2001). Isaac stated, "If we had periodic professional development devoted specifically to science, I think it would be a lot better for everyone." Novice elementary teachers need to learn the science content as well as learn how to teach science (Muijs & Reynolds, 2015; Ross, 2013). Creating dedicated professional learning opportunities related to learning science content and delivering science lessons, implementing professional learning communities, and increasing science course requirements in teacher preparation programs would increase the self-efficacy of the novice elementary teacher in regard to science content.

Administrators and curriculum directors must ensure that teachers have the resources necessary to teach effectively by increasing teachers' PCK (Edmond & Hayler, 2013). This includes having appropriate professional learning opportunities that focus on elementary science. Professional learning should meet the needs of the teachers and the teachers, much like the teachers in this study, need extra assistance relating to science PCK.

Educational stakeholders should consider and implement ways of having teachers to mentor and collaborate in order to reinforce the information delivered through the professional learning sessions. Some participants shared that they have only survived because of their teacher peers and the help that they have extended to them. Katherine stated,

> Had it not been for the teacher next door to me, I probably would have just skipped science altogether. I was so frustrated, but she helped me to see that it was not as bad as I made it seem.

Those experienced peers must be the lifeline for the novice teachers. Having a productive exchange with veteran educators has been shown to have positive impacts on novice teacher self-efficacy (Klassen et al., 2011). Professional learning communities would enable this exchange between novice and veteran educators.

The inclusion of more science content classes as well as more science method courses is essential to improving science PCK and improving novice teacher self-efficacy. Many of the participants in this study had only one required science content course and did not have to complete a science methods course in their preparation program. This is one of the major reasons the teachers did not have the appropriate levels of science PCK. The teachers were not required to take the courses that contain the information they are expected to deliver to the students once they graduate and become state-certified teachers.

Delimitations and Limitations

Delimitations to this study included restricting the study to schools in central Georgia in order to focus on the scope of experiences of the participants. A transcendental phenomenological approach was chosen for this study because I wanted to separate my own experiences of being a science teacher from the past experiences of the participants. Further, the aim of this study was to describe the phenomenon of self-efficacy of novice elementary teachers while teaching science (Ross, 2013). The participants in this study were purposefully selected in that they were novice elementary teachers who did not team-teach and had not completed any post-certification programs for science.

Limitations of this study included a lack of control as to the type of school setting, including size. I could not control the schools that accepted or rejected my invitation to participate in the study. This also included the city or county where the school is located in the state of Georgia. The schools may or may not have been Title I funded schools. An additional limitation was the age range of the participants. All of the participants were in their early to mid-20s. Selecting participants with no more than 5 years of experience created a situation in which the participant pool only included a young demographic. The final limitations of the study pertain to the specific teachers in the elementary schools. Purposeful sampling provided a predominately female participant group. Of the study participants, only four were males. Therefore, the male perspective may not be equally represented in the study. The possible amount of female-to-male teacher experiences in this study may not alter the themes and essence of the central phenomenon since 77% of public-school teachers are female (McFarland, Hussar, Wang, Zhang, Wang, Rathbun, Barmer, Forrest Cataldi, & Bullock Mann, 2018).

Recommendations for Future Research

Teacher self-efficacy is a current and prevalent issue that deserves to be studied further. Teacher attrition continues to be an issue for schools. Therefore, the scope of interest in conducting research on this topic should extend beyond novice teachers. Education is a common topic that can be studied and examined from many perspectives. Even though the results of this study happened to support many of the findings discussed in the literature review, the delimitations and limitations of this study indicated that there are several opportunities to conduct more research.

According to a 2018 report to the National Center for Education Statistics (NCES), 77% of public-school teachers are female (McFarland, et al., 2018). Of the 12 participants, eight were female. A phenomenological study that involves an equal representation of male novice teachers may add further information to studies of novice teacher self-efficacy. In response to certain interview questions, the male perspective differed greatly from the female perspective as the males tended to be less likely to admit weakness or defeat. Even though gender differences were beyond the scope of this study, it would be worthwhile to study the impact of gender as it relates to novice elementary teacher self-efficacy.

In addition, all of the study participants were around the same age which was the early to mid-20s. The eldest participant was just 26 years old. A phenomenological study that involves more varied ages of research participants may, too, add further information to studies of teacher self-efficacy. As humans age, the perceptions change. A phenomenological study centered on different ages may reveal different perspectives of the perceptions of the lived experiences of those subjects. Further, quantitative research should be conducted to quantify the experiences of self-efficacy and PCK. A quantitative study would add to the body of knowledge by creating statistics to quantify the attitudes or behaviors of the research subjects.

Conducting case studies of individual schools and preparation programs in various areas of the United States is recommended for future studies. All of the participants of this study completed their teacher preparation programs in Georgia-based colleges or universities. All of the preparation programs had similar requirements. Including participants who received degrees from other states would add to the knowledge base of the topic of self-efficacy and PCK. By studying individual programs in various parts of the United States, the research would reveal any anomalies associated with geography. Geography may have an impact upon the experiences of the study participants.

Additionally, conducting a phenomenological study of the perception of veteran teachers would provide an interesting and informative study to determine if the issue is just one for novice educators or if it endures throughout a career. The focus of this study was on novice educators and a few of the participants received guidance from veteran educators. However, there were a few participants that mentioned some of their educator peers either would not or could not assist them. It would be interesting to see how the description of the perceptions of veteran elementary teachers would add to the body of research in the area.

Lastly, the aforementioned studies should be conducted in other countries besides the United States to understand if self-efficacy related to science PCK is an issue only for the United States or if it is a pervasive issue that impacts other countries as well. There is the chance that different social and cultural actions, beliefs, and educations could result in differences as it relates to teacher self-efficacy and PCK. This study would allow those in the United States to understand if issues that have arisen here are unique to this country.

Summary

The purpose of this study was to understand the perceptions of self-efficacy in science PCK for novice elementary school teachers at five elementary schools in central Georgia. The findings of this research revealed varied experiences of novice elementary teachers and self-efficacy related to science PCK. Although participants in this study expressed their love of the teaching profession, most of them expressed negative emotions when confronted with teaching science at the elementary level. This negatively impacted their self-efficacy. Participants admitted their lack of science PCK and were willing to work to improve it but had few resources.

In this study, participants described a willingness to put in extra effort to provide their students with the education they needed. However, they were often met with insufficient resources and assistance. In order for the novice teacher to experience positive self-efficacy when teaching science, there must be more science incorporated in teacher preparation programs, more professional development opportunities while on the job, and professional learning communities to provide novice and veteran teachers the opportunity to not only collaborate, but also to share ideas and experiences.

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APPENDIX A: IRB APPROVAL

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

November 21, 2018

Graquetta Banks Harris
IRB Approval 3474.112118: Novice Elementary Teachers' Self-Efficacy for Teaching Science: A Phenomenological Study

Dear Graquetta Banks Harris,

We are pleased to inform you that your study has been approved by the Liberty University IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

> 6. Collection of data from voice, video, digital, or image recordings made for research purposes.
>
> 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

[redacted]

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
The Graduate School

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APPENDIX B: INFORMED CONSENT

NOVICE ELEMENTARY TEACHERS' SELF-EFFICACY FOR TEACHING SCIENCE: A PHENOMENOLOGICAL STUDY

Graquetta Harris
Liberty University School of Education

You are invited to be in a research study of novice elementary teachers' self-efficacy for teaching science. You were selected as a possible participant because you have less than five years teaching experience, completed a traditional teacher preparation program, and teach elementary science. I ask that you read this form and ask any questions you may have before agreeing to be in the study.

Graquetta Harris, a doctoral candidate in the school of education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to understand the perception of novice elementary teachers' self-efficacy for teaching science. I am hoping to find how confident the teachers with fewer than five years teaching experience are with science content knowledge and how to teach it.

Procedures: If you agree to be in this study, I would ask you to do the following things:

1.) Participate in a confidential 12-question interview about your experiences teaching science at the elementary level and your experience with the teacher preparation program with no session lasting longer than 30 minutes. The interview will be audio and video recorded for transcription purposes. You may be contacted after individual interviews for a follow-up interview, which will not last longer than 30 minutes, if necessary.
2.) Complete a Science Teaching Efficacy Belief Instrument with no session lasting longer than 15 minutes. The belief instrument will be used to further gauge self-efficacy beliefs.
3.) Participate in a focus group of other novice elementary science teachers to describe experiences of teaching science at the elementary level not to last more than one 30-minute session. The focus group will be audio and video recorded for transcription purposes.
4.) Participants will be asked to member check the transcription and data analysis for accuracy of the lived experiences with sessions lasting no longer than 30 minutes.

Risks and Benefits of being in the Study: The risks involved in this study are minimal and are no more than the participant would encounter in everyday life. There are no direct benefits to participants; however, there may be a benefit to society for preparing pre-service and in-service teachers with appropriate training to be confident when teaching science to improve instruction provided to students.

Compensation: A $5 gift card for coffee will be provided to participants who complete all aspects of the study. Disbursement of the coffee gift card will occur immediately after the conclusion of the focus group interview.

Confidentiality: The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject or school. Participants and schools will be assigned pseudonyms. Research records will be stored securely and only the researcher will have access to the records. I may share the data I collect from you for use in future research studies or with other researchers; if I share the data that I collect about you, I will remove any information that could identify you before I share it. All data will be kept in locking file cabinets, USB drives will be kept in a portable locking container and recording devices will be kept in a locking file cabinet when not used for research analysis or data collection. After the mandatory three years, all paper data will be shredded and recycled, audio cassettes used for back up recording will be physically destroyed and computer files will be deleted using a software program that cleans hard drives and deletes information. An editor will be used for final editing of the textural description.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University or your school. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please contact the researcher at the email address included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

Contacts and Questions: The researcher conducting this study is Graquetta Harris. You may ask any questions you have now. If you have questions later, you are encouraged to contact her at gharris35@liberty.edu or 770-468-3525. You may also contact the researcher's committee chair, Dr. Randy Tierce at rtierce@libety.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Institutional Review Board, 1971 University Blvd, Green Hall Suite 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)

__ The researcher has my permission to audio-record me/video-record me as a part of my participation in this study.

____

Signature Date

Signature of Investigator Date

APPENDIX C: INTERVIEW QUESTIONS

Interview Questions

1. Please summarize your current teaching assignment, teaching credentials, and education?
2. How confident are you in what you know about science?
3. How comfortable are you with teaching science topics?
4. How effective do you believe you are in teaching science?
5. How do you activate or stimulate the science learning experience?
6. How do you prevent student misconceptions in the science content?
7. What additional learning materials or resources do you include in your science lessons?
8. Describe your experience with science content when completing your teacher preparation program?
9. What science courses were required in your teacher preparation program?
10. How prepared do you feel to teach science after completing your preparation program?
11. What do you feel could have helped to better prepare you to teach elementary science?
12. Is there anything else you would like to share with me about your experiences?

APPENDIX D: SCIENCE TEACHING BELIEF INSTRUMENT (STEBI)

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APPENDIX E: FOCUS GROUP QUESTIONS

Focus Group Questions

1. Please tell us your name and how many years you have been teaching.
2. Think back to the beginning of your first-year teaching. Describe how well prepared you felt to teach science.
3. How did your first-year progress as you taught science for the first time?
4. How did things change after the first year?
5. What changes did you make to the way you taught science after your first-year teaching?
6. How has your confidence changed from the beginning of your first-year teaching to this point?
7. How do you feel your confidence in teaching science impacted your teaching methods?