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Preschool Teachers' Attitudes and Beliefs Toward Science

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COLLEGE OF EDUCATION

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Sharon Lloyd

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2016

Abstract

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by

Sharon Henry Lloyd

MA, Nova Southeastern University, 2004

BS, University of Central Florida, 1987

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

In the United States, a current initiative, Advancing Active STEM Education for Our Youngest Learners, aims to advance science, technology, engineering, and math (STEM) education for the youngest learners. The purpose of this study was to understand preschool teachers' proficiency with science and address the problem of whether or not science learning opportunities are provided to young children based on teachers' attitudes and beliefs. A theoretical framework for establishing teachers' attitudes toward science developed by van Aalderen-Smeets, van der Molen, and Asma, along with Bandura's theory of self-efficacy were the foundations for this research. Research questions explored preschool teachers' attitudes and beliefs toward science in general and how they differed based on education level and years of preschool teaching experience. Descriptive comparative data were collected from 48 participants using an online format with a self-reported measure and were analyzed using nonparametric tests to describe differences between groups based on identified factors of teacher comfort, child benefit, and challenges. Results indicated that the participants believed that early childhood science is developmentally appropriate and that young children benefit from science instruction through improved school-readiness skills. Preschool teachers with a state credential or an associate's degree and more teaching experience had more teacher comfort toward science based on attitudes and beliefs surveyed. The data indicated participating teachers experience few challenges in teaching science. The study may support positive social change through increased awareness of strengths and weaknesses of preschool teachers for the development of effective science professional development. Science is a crucial component of school-readiness skills, laying a foundation for success in later grades.

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Dedication

This doctoral journey is dedicated to my family. First, to my loving husband, Luke, whose support and encouragement kept me focused. Second, to our four children and their spouses with their cheering and reassuring remarks. Third, to my in-laws, whose goading and patronage provided incentive. Finally, in memory of my parents, who taught me to always keep on learning, as life is a journey.

Acknowledgments

I would like to acknowledge and give my sincere appreciation to my committee members. I am tremendously grateful for the diligent support and guidance of my doctoral chair, Dr. Maryanne Longo. Her invaluable expertise, help, and words of encouragement throughout the doctoral journey provided the guidance necessary for completion. My methodologist, Dr. Donna Brackin, added a critical eye, useful suggestions, and more words of encouragement. Thank you, Dr. Maryanne Longo and Dr. Donna Brackin; your support was truly appreciated.

I would like to acknowledge the preschool teachers who participated in this research. Thank you for being part of this study and being early childhood educators. You share your enthusiasm and curiosity with young children and lay the foundation for later learning. A thank you to future preschool teachers who will guide young children on a journey to lifelong learning.

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Chapter 1: Introduction to the Study

Early childhood educators' attitudes and beliefs guide their behavior in the classroom, determining what is shared with young children. Science education in the early years is important for developing critical thinking skills and laying a foundation for science. Multiple researchers (Merino, Olivares, Navarro, Avalos, & Quiroga, 2014; Morrison, 2012; Tao, Oliver, & Venville, 2012) have determined that early childhood science fosters scientific literacy, develops scientific perspectives, and provides a specific knowledge foundation increasing later science understanding for young children. Early childhood science activities influence children's attitudes about science (Spektor-Levy, Baruch, & Mevarech, 2013) and impact overall scholastic achievement.

Science understanding is assessed by the end-of-grade science test for fifth grade students in an eastern state. The reported scoring for the science test is based on Levels 1 through 5, with Level 3 or above considered grade proficient. In 2013-2014, 64.2% of fifth graders in the state were grade proficient on their end-of-grade science test (NC School Report Cards, 2013-2014). However, for 12 northeastern districts, the average was 40.7% for fifth graders proficient on the end-of-grade science test (NC School Report Cards, 2013-2014). The range for these district scores was 21.4% to 56.5% for fifth graders proficient on the end-of-grade science test. The 12 districts were in counties that had a Tier 1 designation from the state department of commerce, which means that they were 12 of the 40 most distressed counties for economic well-being in the state (NC Commerce, 2015). These 12 districts provide preschool programs for young children addressing school readiness domains including science.

The purpose of this study was to research preschool teachers' attitudes and beliefs toward science that impact students' experiences, and therefore their proficiency, with science. Section 2 of this paper provides research on what constitutes early childhood science and the benefits and value of early childhood science for children. The section continues with research regarding attitudes and beliefs, methodologies used for studying, and how teachers' experiences relate to attitudes, beliefs, and the development of science practices. A section is included on professional development.

Problem Statement

Science is a crucial component of school readiness skills, laying a foundation for success in later grades, but is traditionally not addressed in early childhood classrooms (Kermani & Aldemir, 2015). The problem of whether or not young children experience science learning opportunities can be largely attributed to teachers' attitudes and beliefs about teaching science. Early childhood educators' attitudes and beliefs guide their behavior in the classroom, determining what is shared with young children. Preschool teachers with positive attitudes toward science tend to lead young children to develop positive attitudes toward science for future school years and possibly future science careers (Kelly, 2015). The reverse is also true: Preschool teachers who dislike science or have a negative attitude toward science tend to avoid science (Avery & Meyer, 2012). Preschool teachers who provide early childhood science experiences have been shown to build a foundation (Aldemir & Kermani, 2014) for science in later years.

Researchers have established that attitudes and beliefs are important to consider when examining teacher confidence, quality of instruction, and the frequency of science-related activities (Maier, Greenfield, & Bulotsky-Shearer, 2013; Sackes, 2014). A self-report questionnaire was used to research preschool teachers' attitudes and beliefs toward science. The data collected from preschool teachers was analyzed to determine if attitudes and beliefs toward science vary based on the education level of the preschool teacher. Years of preschool teaching experience was the second variable researched to identify if differences exist in attitudes and beliefs toward science.

Purpose of the Study

The purpose of this study was to research preschool teachers' attitudes and beliefs toward science using a self-report measure. Educators' attitudes and beliefs influence instructional decisions, which, in turn, influence learning opportunities provided to children (Rubie-Davies, Flint, & McDonald, 2012). The amount of instructional time spent on science activities varies greatly, from an average of 44 minutes per week to 26 minutes per day, but in general is limited, with little effective instruction occurring (Alboin & Spence, 2013; Nayfield, Brenneman, & Gelman, 2011; Piasta, Pelatti, & Miller, 2014). This is disturbing, as research has shown that early childhood science experiences build a foundation for interest in science (Aldemir & Kermani, 2014), empower preschool children (Andersson & Gullberg, 2014), refine children's creativity (Morrison, 2012), and provide opportunities for young children to share ideas and explorations with each other (Ogu & Schmidt, 2013). The preschool teacher "plays a critical role in helping children learn science content and skills" (Brenneman, 2014, p. 2). Science is a key instructional area for early childhood education, laying the groundwork for elementary school science.

Research Questions

This research was guided by the following questions to support the collection of meaningful quantitative data by which to understand the perspectives of preschool teachers.

1. What are the attitudes and beliefs of preschool teachers toward science?
2. What are the differences in attitudes and beliefs toward science based on the education level of the preschool teacher?
3. What are the differences in attitudes and beliefs toward science based on years of preschool teaching experience?

Theoretical Foundation

This study was based on the principle that attitudes and beliefs guide behavior. Researchers van Aalderen-Smeets, van der Molen, and Asma (2012) developed a theoretical framework to study primary teachers' attitudes toward science. Their framework contains three components and seven underlying attributes (van Aalderen-Smeets et al., 2012). *Cognitive beliefs* is the first component and pertains to perceived relevance, difficulty, and gender beliefs related to science. The second component, *affective states*, encompasses the enjoyment and/or anxiety an individual experiences toward science. The final component, *perceived control*, includes self-efficacy and context dependency. The theoretical framework of van Aalderen-Smeets et al. (2012) was developed by researching both personal and professional attitudes toward science.

The attribute of self-efficacy within the perceived control component was developed from Bandura's social cognitive theory. Bandura (1977) proposed that individuals' personal belief in their ability to perform a task influences their behavior. Personal self-efficacy is based on four sources of information: (a) performance accomplishment or firsthand experiences, (b) vicarious experiences through modeling, (c) verbal persuasion, and (d) physiological state, referring to the affective state of emotional arousal. Personal self-efficacy is the belief that one can succeed. Self-efficacy relates to attitudes, due to perceptions of abilities toward science according to van Aalderen-Smeets et al. (2012). Preschool teachers' attitudes and beliefs towards science influence their behavior.

Nature of the Study

A quantitative study was used to determine preschool teachers' attitudes and beliefs toward science. Specifically, I chose a descriptive comparative design using a self-report survey. Survey research is a justifiable means of gathering quantitative data from a large sample population in order to describe attitudes and beliefs (Creswell, 2012). Survey data were collected via a web-based format from preschool teachers in the selected state. A pre-established tool, Preschool Teacher Attitudes and Beliefs Toward Science (P-TABS; Maier et al., 2013), served as the dependent variable and was used to gather preschool teachers' attitudes and beliefs toward science (Appendix A). Permission to use the survey was granted by Michelle Maier (Appendix B). One independent variable was the education level of the preschool teachers, which was analyzed using the Mann-Whitney U test. The Kruskal-Wallis H test was conducted to analyze the second variable of the years of preschool teaching experience. The methodology of the research and the P-TABS are described in Section 3.

Definitions

Attitudes: Attitudes can be divided into personal and professional attitudes toward science. Personal attitudes toward science refer to an individual's feelings, thoughts, and interest in science and desire to learn more about science. Professional attitudes toward science relate to the value of science education, thoughts about the characteristics of teaching science, and feelings about the level of difficulty in teaching science (van Aalderen-Smeets et al., 2012, p. 160).

Beliefs: Beliefs are a part of an integrated system that includes self, pedagogy, knowledge, and students. Beliefs can best be understood by looking at continuums: implicit to explicit, stable to dynamic, context dependent to context independent, and knowledge to belief, according to Fives and Buehl (2012).

Head Start, an Office of the Administration for Children and Families: The Head Start program provides support to children of low-income families from birth to age 5. The program promotes school readiness through education, health, nutrition, and social services, addressing the mental, social, and emotional development of young children (Head Start, 2015a).

Head Start Child Development and Early Learning Framework: The framework represents Head Start's approach to school readiness and is aligned with the National Education Goals Panel's five essential domains: approaches to learning, language and literacy, cognition and general knowledge, physical development and health, and social and emotional development. Science knowledge and skills fall under the cognition and general knowledge domain. The focus is on helping children learn scientific skills and methods and helping children acquire conceptual knowledge of the natural and physical world (Head Start, 2015c).

Head Start requirements for preschool center-based teaching staff: As of October 2011, preschool teaching staff must have an associate, baccalaureate, or advanced degree in early childhood education. Other options include having related degrees with experience working with preschool children (Head Start, 2015b).

North Carolina Association for the Education of Young Children (NCaeyc): NCaeyc is an organization that is promoted as the voice of early childhood professionals in the state of North Carolina. NCaeyc's mission is to educate, advocate, and motivate early childhood professionals, including teachers, childcare providers, administrators, and researchers, to name a few. NCaeyc is affiliated with the National Association for the Education of Young Children (NCaeyc, 2013).

North Carolina star-rated license for child care centers: Child care centers in the state are issued star-rated licenses from the Division of Child Development. A one-star-rated license facility meets the minimum standards. Each facility has the option of applying for a two- to five-star-rated license based on points earned in two areas, program standards and education standards. Child care centers that have earned a four-star- or five-star-rated license offer science at least weekly (North Carolina Division of Child Development and Early Education [NCDCDEE], 2015a).

North Carolina requirements for preschool teaching staff: Preschool teachers are required to have the North Carolina Early Childhood Credential (NCECC) or equivalent. Equivalency options include a 2-year degree in either early childhood, child development, human growth and development, or early childhood special education, or completion of a specified number of courses within other 2-year degree programs. Preschool teachers may also hold a North Carolina birth-to-kindergarten license, a 4-year degree program (NCDCDEE, 2015b).

Preschool Teacher Attitudes and Beliefs Toward Science Questionnaire (P-TABS) is an established questionnaire that contains 35 items. The content breakdown of the P-TABS is as follows: 14 items addressing teacher comfort, 10 items related to child benefit, seven items associated with challenges, and four items that do not specifically address the three identified factors. A 5-point Likert scale ranging from *strongly disagree* to *strongly agree* is used to score the questionnaire (Maier et al., 2013). See Appendix A for sample of P-TABS.

Self-efficacy: Self-efficacy is the notion that one has the power to execute a behavior or produce an effect. Personal efficacy is based on four sources of information: mastery experience, vicarious experience, verbal persuasion, and physiological states or affective states, according to Bandura (1977, p. 195).

Survey Monkey: Survey Monkey is online survey and questionnaire software. Participants of this research study accessed Survey Monkey via a web link provided on an invitation to participate in research in order to take the P-TABS questionnaire electronically. Survey Monkey can be accessed online: https://www.surveymonkey.com.

Assumptions

The underlying assumptions for this research addressing preschool teachers' attitudes and beliefs toward science included the following:

1. The preschool teachers taught an approved program.
2. The P-TABS was completed by preschool teachers.
3. The teacher held the appropriate credentials, with documentation held at the organizations' location.
4. The teacher answered the questions honestly, rather than stating what they perceived to be the "correct" answers.

These assumptions were necessary because the data collection tool was anonymous.

Scope and Delimitations

The scope of the research was preschool teachers throughout the selected state. Preschool teachers were the specific focus because for young children, science learning opportunities that lay a foundation for science achievement in the later grades can be attributed to preschool teachers' attitudes and beliefs toward teaching science. The surveys were distributed to Head Start directors to share with preschool teachers who worked with 3-year-olds or 4-year-olds. Other public and private preschool teachers who were members of the North Carolina Association for the Education of Young Children (NCaeyc) received the opportunity to participate in the research through a Facebook invitation. Preschool teachers employed at four-star- or five-star-rated licensed child care centers were invited to participate in the research. The potential for generalizability is limited to the selected state.

Limitations

The main limitation to this study was the P-TABS, which is a self-report survey. The teachers' attitudes and beliefs may not reflect actual practice. A second limitation was the individual teachers' breadth and depth of science instructional knowledge. Differences in teaching strategies vary from one teacher to another, and differences in years of teaching experience may present a limitation to the study. The research participants were preschool teachers representing only one state, presenting a third limitation.

Significance

The significance of this study rests in the effort to ascertain preschool teachers' attitudes and beliefs toward science, which play a critical role in their classroom practice. Research has shown that science opportunities during the preschool years lay a foundation for elementary science (Merino et al., 2014; Morrison, 2012; Tao et al., 2012). If preschool teachers and young children can be coinvestigators making sense of the world, children will most likely develop a positive attitude toward science. Young children's positive attitudes toward science can be the antecedent to science proficiency at the end of fifth grade, a pivotal assessment year. This is important because professionals are needed to fill STEM careers in the 21st century. Positive social change may occur through increased awareness of strenghts and weaknesses of preschool teachers for the development of effective science professional development in light of preschool teachers' attitudes and beliefs toward science. Preschool teachers can then use this knowledge to facilitate science opportunities for early learners.

Summary

Preschool teachers are responsible for addressing school readiness domains, including science, when working with young children. The focus of this research was to identify preschool teachers' attitudes and beliefs toward science. An individual's attitudes and beliefs are significant predictors of behavior. For this quantitative study, the P-TABS self-report survey developed by Maier et al. (2013) was used to gather participants' perspectives toward science. The collected data were used to identify differences between preschool teachers based on their education level and the number of years of preschool teaching experience.

The remainder of this dissertation is comprised of Section 2, the literature review; Section 3, the research method; Section 4, results; and Section 5, discussion, conclusions, and recommendations. The literature review begins with establishing what constitutes early childhood science. Following that, the benefits and value of early childhood science for young children are reviewed. Next, research about attitudes and beliefs is reviewed, followed by literature on how attitudes and beliefs relate to teachers' education and experience with development of science practices. Following that, a section reviewing professional development and how it relates to attitudes and beliefs is presented. The final focus is on the selected methodology used to study preschool teachers' attitudes and beliefs.

Section 3 of this paper delineates the research method chosen for the study of preschool teachers' attitudes and beliefs toward science. A descriptive comparative survey was selected as the design and approach of the study, administered through a web-based format. Next, the setting and the sampling of preschool teachers are discussed. The instrumentation and materials are explained, followed by data collection and analysis.

The section concludes with measures taken to protect participants' rights and my role as the researcher.

Section 4 presents the results of this study on preschool teachers' attitudes and beliefs toward science. The section provides information on the data collection process, the instrumentation, and the setting and sample. The results are analyzed and presented in an effort to answer each of the three research questions.

The final section of this dissertation contains discussion, conclusions, and recommendations as a result of the analysis of data. Key findings are shared, followed by interpretation of the findings. Limitations as well as recommendations for action and further study are presented. The dissertation concludes with implications for social change and initiatives for advancing science, technology, engineering, and math (STEM) education for the youngest learners.

Chapter 2: Literature Review

Science education for the youngest learners is important for developing critical thinking skills and laying a foundation for science. Preschool teachers' attitudes and beliefs toward science determine what science may or may not be shared with young children. Current research describes what early childhood science is and the benefits young children receive from science investigations. Information was garnered in regard to educators' attitudes and beliefs in general and in relation to education, experience, and self-efficacy. Research revealed the value of support and professional development addressing attitudes, beliefs, and science. The final section of the literature review describes quantitative methodology used in studying attitudes and beliefs.

Literature Search Strategy

The literature review was driven by the research question: What are the attitudes and beliefs of preschool teachers toward science? The literature review was conducted using Walden University's online databases and included a wide range of peer-reviewed journals, articles, and studies. Education Resources Information Center (ERIC), Education Research Complete, and PsycINFO were accessed to find literature related to preschool teachers' attitudes and beliefs toward science from the year 2011 to the present. Keywords for searches included *attitudes*, *beliefs*, *science*, *elementary*, *preschool*, *teacher*, *self-efficacy*, *professional development*, and *Head Start*. In most cases, the terms were searched using *and* with keywords. Thoreau multiple database and Google Scholar search engines were used, alternating the keywords in order to find more articles related to preschool teachers' attitudes and beliefs and science.

Science in Early Childhood

"Young children making sense of their world" is an apt description for science in early childhood settings. Preschoolers are naturally curious and enthusiastic about learning and have a sense of wonder as well as persistence (Dominguez, McDonald, Kalajian, & Stafford, 2013; Erden & Sonmez, 2011; Howitt, Lewis, & Upson, 2011). These characteristics provide young children with the capacity to engage in science concepts (National Science Teachers Association [NSTA], 2014). Young children embrace the world through total sensory exploration, which aids in scientific thinking (Spektor-Levy, Baruch, & Mevarech, 2013). Preschool teachers can enhance this sensory exploration by guiding children's interest and everyday experiences into science investigations. Everyday experiences that can become science investigations include those involving wiggly worms (Dominguez et al., 2013), sunflower seeds (Roseno, Geist, Carraway-Stage, & Duffrin, 2015), and instruments (Smith & Trundle, 2014). Life, physical, and earth science concepts are appropriate in early childhood science if encountered in everyday activities.

Hamlin and Wisneski (2012) researched play experiences and found that they can lead to science learning and investigations. When young children are using their five senses to explore, they are involved in functional play. Preschool teachers can scaffold children's learning through literature and by providing tools that enhance the senses. Preschool children can move to symbolic play, using objects and language to represent ideas (Hamlin & Wisneski, 2012) through high-quality teacher interactions. These interactions include modeling, thinking, and problem solving in addition to allowing time for sensory learning (Dubosarsky, et al., 2011). High-quality interaction is one strategy for extending the science interest of young children.

Preschool teachers incorporate a variety of strategies to enhance young children's ability to grasp science concepts in the early childhood classroom. Watching and listening to young children is the foremost strategy (Edson, 2013; Hyson & Tomlinson, 2014). Andersson and Gullberg (2014), researching five preschool and primary teachers in Sweden, found that actively listening and being a part of the children's situation represent a science competency. Children's natural curiosity and questions provide a direction for science investigations in which preschool teachers build upon topics worthy of study. The preschool teacher who is alert, identifying teachable moments or "capturing the unexpected" (Andersson & Gullberg, 2014, p. 287), is addressing science in the early childhood classroom. Science is seen as an engaging practice for both preschoolers and their teachers.

Preschool teachers engage with children by listening to and appreciating questions they ask (Sharapan, 2012). Questioning is another strategy used to advance science in the early childhood classroom. Ashbrook in *Science Learning in the Early Years: Activities for PreK-2* (2016) established the importance of teachers creating opportunities to develop and support questioning skills with children. Preschool teachers develop a culture where children feel safe, valued, and respected for asking questions and seeking answers, which encourages more questioning on the part of children. Another way in which preschool teachers create these opportunities is by asking open-ended questions related to everyday experiences. Preschool teachers who use open-ended questions that allow for multiple answers start young children on the path of science inquiry (Ogu & Schmidt, 2013). The next step with questioning is scaffolding children's ideas to formulate testable questions. Andersson and Gullberg (2014) identified the competency as asking questions that challenge young children to reformulate questions into testable investigations. Acquiring the skill of productive questioning moves preschool science activities from incidental learning to intentional learning (Smith & Trundle, 2014). Incidental learning is the elaboration of children's interest to an incident—that teachable moment—whereas intentional learning involves planned, prepared, and presented science activities and lessons.

A variety of approaches for early childhood science occur in different countries. Hammer and He (2014) researched preschool teachers' approaches to science, comparing a Chinese kindergarten containing children ages 3 to 6 with a Norwegian kindergarten containing children ages 1 to 6. The Chinese kindergarten followed a more programmed approach, with teacher directed activities that were well planned with clear objectives, consistent with Chinese culture of academics and learning. The Norwegian kindergarten was a combination of an open framework and a child-centered approach. The open framework approach has adults providing support and allowing children free access to the environment for exploring. In a child-centered approach, the children initiate activities in an open-ended environment. This is consistent with Norwegian culture, in which children are seen as born curious and as learning by experiencing the environment (Hammer & He, 2014). Another set of researchers interviewed 20 preschool teachers from Attica, Greece, searching for a connection between teaching strategies and science content knowledge (Kavalari, Kakana, & Christidou, 2012). The researchers' results revealed two approaches. The first was an empirical approach whereby children gather information using their senses and the teachers perform demonstrations to transmit knowledge. This approach lacked observations and the drawing of conclusions. The second approach, referred to as *contemporary*, was based on children's predictions and included systematic experimentation and observation. The teacher served as a facilitator.

An early childhood educator's primary role is facilitator of science. The preschool teacher engages in science talks, drawing out children's ideas, and engaging children in conversation (Mohrbacher, 2015). Conversations lead to investigations, and children are encouraged to make discoveries. As facilitators, preschool teachers' model excitement and enthusiasm for science, which in turn help children build positive attitudes toward science. Preschool teachers with a "sciencing attitude" design an environment that stimulates interest and promotes science opportunities (Fitzgerald, Dawson, & Hacklings, 2013; Fleer, Gomes, & March, 2014). Science materials such as hand lenses, magnets, and microscopes; science equipment such as measuring tools, binoculars, and prisms; and natural materials such as plants, feathers, and pine cones are items that stimulate interest and promote science opportunities. Sensory sand and water tables in the environment provide opportunities for science investigations.

Early childhood educators have identified the environment—more specifically, the resources in the environment—as a challenge to science (Tank, Pettis, Moore, & Fehr, 2013). Science lessons require consumable and nonconsumable materials for children to carry out investigations. Gathering the resources requires time and funding.

Time is considered a challenge due to preparation for investigations, time for carrying out investigations, and the need to clean up afterward (Tank et al., 2013). Another challenge preschool teachers might encounter is lack of science content knowledge (DeJarnette, 2012). Timur (2012) researched Turkish preschool teacher candidates who felt that they had a positive attitude toward science but lacked science content knowledge. The candidates believed that science instruction improves with experience. Even with the challenges, preschool teachers have expressed the belief that scientific education that fosters scientific literacy should begin in the early years, ages 2 to 6 (Merino et al., 2014). Early childhood educators who have positive attitudes and beliefs toward science know that science skills equal learning skills for young children.

Benefits of Science for Young Children

The benefits young children receive from early childhood science opportunities cross all school-readiness domains. Skills preschoolers learn include observation, investigation, collaboration, communication, measurement, prediction, interpretation of information, and problem solving (Ashbrook, 2016; Edson, 2013; Morrison, 2012). In the area of literacy, nonfiction texts expose young children to higher levels of vocabulary, expanding preschoolers' word knowledge (Gerde, Schachter, & Wasik, 2013; Patrick, Mantzicopoulos, & Samarapungavan, 2013). Children learn about prediction and inference through science investigations, which, in turn, aid in listening comprehension. The reverse is also true: Fictional text is an impetus for science investigations. "The Three Little Pigs" is an engagement activity for a study of construction and destruction exploring force and motion, while "Frosty the Snowman" introduces the topic of weather, seasons, and the water cycle (Jones, 2014). Through literary text and science investigations, preschoolers' writing skills are developed.

Writing is a form of communication that young children can use to share their science investigations. The school year begins with the preschool teacher using a blank big book as a class science notebook to demonstrate the importance of recording information through drawing and student dictation (Edson, 2013; Gerde et al., 2013; Patrick et al., 2013). Eventually, preschool children want to communicate using their own science notebooks. Young children begin with simple drawings and recorded dictation. As the year progresses and their observational skills improve, the preschoolers' drawings begin to show more detail. Preschoolers' language skills are developed during dictation to the teacher as they describe the drawings. Quality interactions between child and teacher build social-emotional skills.

Collaboration between children during science opportunities strengthens individual students' social-emotional skills. From the teacher's point of view, the social aspect of scientific thinking in cooperative groups is a positive outcome of scientific curiosity in preschoolers (Spektor-Levy et al., 2013). Children learn that it is acceptable to work with others, sharing ideas and finding multiple solutions (Tank et al., 2013). Torquati, Cutler, Gilkerson, and Sarver (2013) compared science and nature activities with other curricular areas and determined that teachers believe that social-emotional learning outcomes are most important. Hollingsworth and Winter (2013) stated that social-emotional skills are more important than cognitive skills. Young children build self-confidence as they collaborate with others and problem solve. Self-confidence is a stimulus effecting school-readiness domains.

Young children learn mathematics readiness skills during science investigations. According to the National Science Teachers Association (NSTA, 2004) position statement on early childhood science education, “science provides a purposeful context for use of math skills and concepts” (p. 4). Sorting, classifying, and counting are math skills used in context when exploring rocks (Ogu & Schmidt, 2013). Measurement concepts are easily addressed through direct comparison of objects or measuring bear paw prints with “It’s a Mystery” (Howitt, Lewis, & Upson, 2011). Everyday experiences that involve recording the weather or the shape of the moon develop patterning concepts. Young children benefit from science opportunities that also enhance multiple school readiness domains.

Attitudes and Beliefs of Educators

Early childhood educators’ attitudes and beliefs are important variables to consider when examining classroom science (Erden & Sonmez, 2011; Maier et al., 2013). Attitudes toward science are categorized as personal and professional (van Aalderen-Smeets et al., 2012). An individual’s feelings, thoughts, and interest in science as well as desire to learn more about science are personal attitudes. Professional attitudes toward science involve characteristics and level of difficulty in teaching science. Whether or not a preschool teacher sees value in science education is attributed to professional attitude. Both personal and professional attitudes were taken into consideration when van Aalderen-Smeets et al. (2012) developed their theoretical framework establishing primary teachers' attitudes toward science. The framework has three components: cognitive beliefs, affective states, and perceived control, as discussed earlier.

An attribute of perceived control is self-efficacy, proposed by Bandura (1977). *Self-efficacy* is the notion that one has the power to execute a behavior and/or produce an effect. Bandura (1977) stated, "The strength of people's convictions in their own effectiveness is likely to affect whether they will even try to cope with given situations" (p. 193). *Personal self-efficacy* is the belief that one can and will try to succeed.

Fives and Buehl (2012) are two more researchers who "view beliefs as precursors to action" (p. 481). Fives and Buehl synthesized research related to teachers' beliefs in hopes of clarifying the construct. Their research led to the identification of characteristics of teachers' beliefs, which fall on continuums. The poles of the first continuum are implicit (unaware) and explicit (conscious) beliefs. On one end of the second continuum, beliefs are stable and resistant to change; on the other end, beliefs are dynamic and thus changeable based on experiences. Context dependent and context independent are the poles of the third continuum, referring to whether beliefs change with regard to a situation or stay constant. The fourth characteristic focuses on whether knowledge and belief are distinctly different, the same, or related. Fives and Buehl contended that knowledge and belief are interwoven. The final characteristic is that beliefs are part of an integrated system that includes self, education, knowledge, and the students whom preschool educators teach. Early childhood educators' attitudes and beliefs guide their behavior in the classroom, determining what is shared with young children.

Multiple researchers have determined that attitudes and beliefs influence instructional decisions and practices. Some of the research has shown a positive correlation, whereas other findings have been inconsistent. Merino et al. (2014) determined a link between science beliefs and practices, with students acquiring meaning through direct activities. Rubie-Davies, Flint, and McDonald (2012) confirmed that beliefs influence instructional decisions, which in turn influence learning opportunities provided to children. Erden and Sonmez (2011) found that early childhood teachers have a positive attitude toward science, but the relationship between attitude and frequency of science activities is weak.

Improvement of science education is the result of primary teachers developing positive attitudes toward science (van Aalderen-Smeets et al., 2012). Teachers' attitudes and beliefs are truly a factor in what they share with their students. Researchers have determined that teacher beliefs are enabling (Edwards & Loveridge, 2011); if teachers believe that they will be successful, they are more likely to be successful (Guo, Justice, Sawyer, & Tompkins, 2011), and they believe in their ability to teach science, then they will be able to teach science (Bautista, 2011). Avery and Meyer (2012) researched preservice elementary science teachers and ascertained that disliking science translates to avoidance of science. Aldemir and Kermani (2014) and Sandholtz and Ringstaff (2011) with American teachers and Albion and Spence (2013) with Australian teachers found that educators who feel less confident in science seldom incorporate science. The reverse is also true: Teachers with higher levels of personal self-efficacy are comfortable and tend to teach more science (Albion & Spence, 2013). In Sweden, Nilsson (2015) found that preschool teachers can build science confidence through coplanning, coteaching, and coreflecting. Positive attitudes and confidence or belief in self relates to scientific learning on the part of the preschool teacher, which can then be shared with young children.

Attitudes and Beliefs of Educators Related to Education and Experience

Education, beliefs, and experience are factors related to instructional decisions in the classroom. Friesen and Butera (2012) researched three Head Start teachers' beliefs and how they connect to instructional decisions. Their research examined beliefs considering ones professional, practical, and personal knowledge as suggested by Vacca, Vacca, Grove, Burkey, Lenhart, and McKeon (as cited in Friesen & Butera, 2012). Professional knowledge refers to an individual's formal academic training to include credentials or degrees that have been earned. Practical knowledge relates to individual experiences in instructing young children. Personal knowledge is the beliefs and attitudes that an individual holds. The researcher's results determined that professional knowledge had a limited role in educator's instructional decisions (Friesen & Butera, 2012). The education level of preschool teachers' has been considered in various research resulting in a variety of conclusions. When researching patterns of school readiness amongst Head Start children, McWayne, Cheung, Green Wright, and Hahs-Vaughan (2012) found that teachers that hold more than a bachelor's degree reported lower social skills for the children. McWayne et al. hypothesized this might be due to the teachers having higher behavioral expectations. Research with 308 early childhood teachers in Turkey concluded that teachers' with an associate degree and more experience had higher self-reported fidelity to the mandated curriculum than teachers with bachelor's degree and less experience (Cobanoglu & Capa-Aydin, 2015). One set of researchers found that preschool teachers' beliefs of creative pedagogy were similar with or without a degree (Cheung & Leung, 2013). My research identified the differences in attitudes and beliefs toward science based on the education level of the preschool teacher.

Practical knowledge or experience is a second variable to consider when studying attitudes and beliefs toward science. According to Friesen and Butera (2012) practical knowledge had a large influence on instructional decisions in the classroom. Roehrig, Dubosarsky, Mason, Carlson, and Murphy (2011) while researching Head Start teachers on an American Indian reservation, identified lack of experience, low self-efficacy, and anxiety as reasons why preschool teachers exclude science from the curriculum. Turkish preschool teacher candidates have overall positive attitudes toward science but felt they lacked science content knowledge and that teaching science improves with experience (Timur, 2012). Sundberg and Ottander (2013) researched preservice preschool teachers and found that positive attitudes grew with experience, building competence, and confidence toward science. Researching 44 preservice elementary teachers, Bautista (2011) determined a science method course which focused on vicarious and mastery experiences was effective in increasing self-efficacy. An individual with a strong science background and experience has a higher level of science self-efficacy according to Mintzes, Marcum, Messerschmidt-Yates and Mark (2013) when researching in-service elementary teachers. However, one set of researchers' Guo et al. (2011) findings were inconsistent on whether teaching experience was associated with teacher self-efficacy.

While, Sackes (2014) determined that teaching experience was not a factor influencing the frequency of science instruction when analyzing Early Childhood Longitudinal Study – Kindergarten dataset. My research answered what are the differences in attitudes and beliefs toward science based on the years of preschool teaching experience.

Mansfield and Woods-McConney (2012) completed focus group interviews with primary teachers from Western Australia to identify sources of teacher efficacy for primary science teaching. The authors referenced three of the four sources of Bandura's personal self-efficacy: mastery experiences, vicarious experiences, and physiological and affective states. Sources of efficacy from mastery experiences included prior experiences with science whether it be during childhood or in university and negative experiences that lead teachers to believe science isn't for them or that they can teach science better than that (Mansfield & Woods-McConney, 2012). Vicarious experiences that were noted as sources of self-efficacy included school wide science events where teachers can learn from others and television science programs that demonstrate quick activities (Mansfield & Woods-McConney, 2012). The teachers think if they can do it, so can I. An inspirational science teacher or a "science champion" an individual that is motivating, positive, and relaxed with science instruction are two physiological and affective sources of self-efficacy (Mansfield & Woods-McConney, 2012). Attitudes, beliefs, and self-efficacy are factors that preschool teachers have toward science.

Professional Development

Professional development is one method for increasing teacher knowledge and skills, or changing attitudes and beliefs which should result in change of instruction and ultimately improve student learning (Desimone & Garet, 2015). There are certain features that should be considered for professional development to be effective. Desimone and Garet referencing an early work of Desimone (2009) when she researched multiple works regarding professional development, determined the following features were represented in most works but may use varying terminology: content focus, active learning, coherence, duration, and collective participation. Content focus referred to the subject of the professional development along with how students learn the subject and considered the most influential feature. An alternate term for coherence is alignment, consistency through beliefs, knowledge, and policies. Duration referred to the timing of the professional development activity as well as the length of the activity. Collaboration is an alternate term for collective participation referring to teachers in the same group or within the same setting. Desimone and Garet identified best practices in teacher professional development and current trends. Professional development should have a sustained content focus linked to classroom lessons and effective implementation occurred with leadership support. Challenges included the function or purpose of the professional development and funding as well as multiple providers of trainings. Professional development is an ongoing and reflective practice.

Professional development is one method for providing social change in light of preschool teachers' attitudes and beliefs toward science. If one considers teachers' learning experience as synonymous with professional development, then professional development occurs in multiple contexts. These contexts include but not limited to coplanning, coteaching, and coreflecting (Nilsson, 2015; Rytivaara & Kershner, 2012), peer observation, mentoring, and collaboration (Mansour, El-Deghaldy, Alshamrani, & Aldahmash, 2014), workshops, book studies, and individual enhancements (Desimone & Garet, 2015). Rytivaara and Kershner (2012) completed an ethnographic study over 3 1/2 years with two educators in Finland which focused on coteaching as a context for professional learning. These researchers determined that professional development is active learning, both individually and in collaboration with others grounded in everyday activities and experimentation. Further, Rytivaara and Kershner (2012) specified that professional development is a long term process, short term programs do not transfer to practice. Long term or continuing professional development allows for the development of knowledge, dialogue with colleagues, and presentation followed by application according to science teachers' perspectives in Saudi Arabia (Mansour et al., 2014). Job embedded professional development allows for continuing professional development. The National Science Teachers Association (NSTA) position statement for early childhood science education recommends that teachers who support science learning be given professional development opportunities that

- engage them in learning science principles in an interactive, hands-on approach, enabling them to teach about science principles appropriately and knowledgeably;
- are ongoing and science-specific;
- help them understand how children learn science and engineering practice;
- inform them about a range of strategies for teaching science effectively; and

- include the use of mentors to provide ongoing support for educators for the application of new learning. (NSTA, 2014).

The many contexts of professional development allows for addressing preschool teachers' attitudes and beliefs toward science.

Professional development can have positive impacts for teachers. Sandholtz and Ringstaff (2011) studied 39 rural kindergarten through second grade teachers that were involved with a 3 year professional development program that included adult science content instruction, science instruction training, and facilitated teacher collaboration. After a year of the program, teacher science self-efficacy was increased, specifically there was a drop from 42% to 18% of teachers claiming "I do not do science well" and 46% to 10% of teachers wondering if they had the skills to teach science (Sandholtz & Ringstaff, 2011). Another 3 year professional development program, this time with Head Start teachers on an Indian Reservation, was successful (Roehrig et al., 2011). The Head Start teachers developed positive dispositions, learned to focus on children's interest, and learned how to make children aware their surroundings and to observe natural world. As stated above, professional learning should be grounded in everyday experiences. Mansfield and Woods-McConney (2012) interviewed 24 primary Australian teachers and learned "efficacy for science teaching can stem from the opportunities for less efficacious teachers to observe and learn from other successful teachers" (p. 49). Not all researchers have found positive outcomes from professional development. Piasta, Logan, Yeager Pelatti, Capps, and Petrill (2015) researched the effects of extended professional development in math and science with 65 educators and determined that it was insufficient to enact change.

Enacting change is somewhat dependent on teacher acceptability of school reform. Donnell and Gettinger (2015) determined four variables to school reform: congruence between the innovation and teachers' beliefs, teachers' personal self-efficacy beliefs, years of teachers' experience, and the level and quality of professional development. If professional development aligns with teachers' beliefs, the higher acceptability and implementation. Enhancing teachers' attitudes is another means for effective professional development. Researchers van Aalderen-Smeets and van der Molen (2015) used their theoretical framework to study primary teachers' attitudes toward science (van Aalderen-Smeets et. al. 2012) and developed a training course which focused on theory components of cognitive beliefs, affective states, and perceived control, and scientific attitudes such as curiosity, inquisitiveness, wonderment, and improving teacher knowledge. Results of their research on the effectiveness of the training course determined that theory components improved, particularly, trained teachers felt more in control, more confidence, and less dependent on context factors (van Aalderen-Smeets & van der Molen, 2015). Focusing on teachers' attitudes improved their attitudes toward science teaching and implementation of science teaching. The effectiveness of professional development or teacher learning is a result of the experiences provided and personal significance.

Methodology for Studying Attitudes and Beliefs of Educators

A variety of methodologies have been used to study attitudes and beliefs of teachers toward science. Sample qualitative analysis include a phenomenological perspective (Westman & Bergmark, 2014) and case study designs (Cowie & Otrel-Cass, 2011; Edwards & Loveridge, 2011). Swedish preschool teachers involved in the phenomenological study “describe themselves as facilitating exploration and learning by appreciating children’s own beliefs, curiosity and initiative” (Westman & Bergmark, 2014, p. 83). Both case studies involved New Zealand early childhood educators and used interviews and observation to gather teacher perspectives. The teachers believed their job is to support children’s science learning through developing knowledge related to children’s interest and guiding children in understanding the nature of science in order to build scientific attitudes in children (Cowie & Otrel-Cass, 2011; Edwards & Loveridge, 2011). Another key perspective is the importance of reflecting on experiences and practices in order to build confidence and scientific learning. Qualitative research methods generate rich detail information regarding teachers’ attitudes and beliefs toward science.

Quantitative research related to attitudes and beliefs use questionnaires. Questionnaires have been developed and validated to study attitudes and beliefs and use Likert scales for the quantitative analysis. A common questionnaire used in studies (Bautista, 2011; Lumpe, Czerniak, Haney, & Beltyukova, 2012; Sackes, Flevares, Gonya, & Trundle, 2012) is the Science Teaching Efficacy Belief Instrument (STEBI) developed by Iris Riggs and Larry Enochs in 1988. The instrument is used with preservice and in-service teachers to measure science teaching efficacy before and after method courses or professional development. Lumpe et al. (2012) used STEBI along with Context Beliefs about Teaching Science (CBATS) to examine professional development on teacher beliefs. The researchers established how often educators teach science is one variable predictive of beliefs. They also determined that classroom practice aligns with teachers' beliefs. Sackes et al. (2012) used the STEBI with 34 preservice early childhood teachers to determine the impact of a methods course and ascertained there is a relationship between experience and self-efficacy. Mintzes, Marcum, Messerschmidt-Yates, and Mark (2013) used Teaching Science as Inquiry (TSI) questionnaire developed by Smolleck, Zembal-Saul, and Yoder, 2006. The TSI uses a Likert scale to measure personal self-efficacy (34 items) and outcome expectancy (35 items). Mintzes et al. completed a 3 year study and determined that professional learning communities related to science effectively increased personal self-efficacy, empowered the teachers, developed collaboration among teachers, and showed positive science outcomes for students.

Some instruments have been developed for early childhood educators. The first is the Early Childhood Teachers' Attitudes toward Science Teaching Scale (ECTASTS) (Cho, Kim, & Choi, 2003; Erden & Sonmez, 2011) which was found to be reliable but construct validity was not supported. The second instrument is the Early Childhood Teacher Experiences Scale (ECTES; Fantuzzo, Perlman, Sproul, & Minney, 2012) which measures early childhood teacher experiences in general and not specific to science but identified that it is critical to pay attention to teacher efficacy. Desli and Dimitriou (2014) developed their own questionnaire to investigate preservice teachers' beliefs and determined beliefs are resistant to change and affect an educators' practice. The early childhood instrument selected for this study is the Preschool Teachers' Attitudes and Beliefs Toward Science Questionnaire (P-TABS) developed by Maier et al. (2013). The item development includes questions from ECTASTS. This instrument was selected as it was found to be a reliable and valid instrument that measures preschool teachers' attitudes and beliefs toward science related to three distinct factors: teacher comfort, child benefit, and challenges. Brenneman (2011) corroborates that P-TABS is a validated measurement used to gather teacher ideas related to science and science teaching after Maier, Greenfield, and Bulotsky-Sheared presented the initial validation of the P-TABS at the biennial meeting of the Society for Research in Child Development.

Mixed method research combining quantitative and qualitative methods is used to study teachers' attitudes and beliefs. Bautista (2011) studied 44 preservice elementary teachers using the STEBI to access quantitative data and employed an informal survey for qualitative data and determined that a science method course that focused on vicarious and mastery experiences was effective in increasing self-efficacy. Guo et al., (2011) used a mixed method approach of quantitative questionnaires and qualitative systematic classroom observation researching teacher efficacy. Their results showed if teachers believe that they will be successful, they are more likely to be successful, that teacher collaboration is positively associated with self-efficacy, and that findings related to years of experience are inconsistent as to the whether or not there is an association with self-efficacy (Guo et al., 2011). Timur (2012) researched preschool teacher candidates in Turkey and identified that teachers have a positive attitude toward science using a quantitative questionnaire. The idea that science teaching improves with experience was determined through qualitative focus group interviews.

The method selected for this research study on preschool teachers' attitudes and beliefs toward science was quantitative. Specifically, a descriptive comparative design using a self-report survey. Other methodologies were considered for this research. A case study design would provide preschool teacher attitudes and beliefs toward science for a small group but I was interested in establishing attitudes and beliefs toward science for a broader population. I considered correlational design relating preschool teachers' attitudes and beliefs toward science with preschool children's science growth but there is a lack of appropriate instruments for measuring preschoolers' science growth (Brenneman, 2011). I pondered causal-comparative research seeking to explain preschool teachers past science experiences with their current use of science opportunities in the classroom. My pondering stopped when I realized I would have a hard time quantifying my science experience in relation to how I currently teach science. The chosen research method of descriptive comparative design is described in the next section.

Summary and Conclusions

Science in the early childhood classroom benefits young children and is a crucial component of school readiness skills as well as fostering scientific literacy. Preschool teachers' attitudes and beliefs along with their education level and years of preschool teaching experience are factors related to instructional decisions in the classroom. Both professional and personal attitudes toward science should be considered for the improvement of science education for preschoolers and beyond. Multiple research using questionnaires or surveys to gather information about educators' attitudes and beliefs toward science is available but limited when the focus is on early childhood science. The next section describes the chosen methodology of descriptive comparative design to gather data related to preschool teachers' attitudes and beliefs toward science.

Chapter 3: Research Method

Science education for the youngest learners is important for developing critical thinking skills and laying a foundation for science. Preschool teachers' attitudes and beliefs toward science determine what science may or may not be shared with young children. Section 3 is divided into the following parts: research design, setting and sampling, instrumentation, data collection and analysis, and measures for ethical protection. Research design includes a description of the selected approach and justification for its use. The location of the study and criteria for selecting participants are developed in the setting and sampling section. A description of the P-TABS self-report measure and its choice for use is presented under instrumentation. The data collection and analysis portion includes a description of how data were collected and analyzed. Measures to ensure participants' rights and the role of the researcher are explained under measures for ethical protection. Section 3 ends with a summary of the research design overall.

Research Design and Rationale

A quantitative descriptive comparative survey design using self-report was used to determine preschool teachers' attitudes and beliefs toward science. Survey research is a justifiable means of gathering quantitative data from a large sample population in order to describe attitudes and beliefs (Creswell, 2012). The groups or independent variables for this study were the participants' education level and their years of preschool teaching experience. The selected survey, serving as the dependent variable, was the Preschool Teachers' Attitudes and Beliefs Toward Science (P-TABS) self-report questionnaire, presented using an online format. This design allowed participants to share their attitudes and beliefs toward science in the early childhood classroom.

Methodology

The methodology chosen for this research study on preschool teachers' attitudes and beliefs toward science was quantitative; specifically, I used a descriptive comparative survey design using self-report. Surveys and questionnaires have been developed and validated to study attitudes and beliefs and commonly use Likert scales for quantitative analysis. The questionnaire chosen for this research was the P-TABS.

Population Selection

The target population was preschool teachers of 3-year-olds or 4-year-olds from the selected state who worked in Head Start centers and four-star and five-star licensed child care centers. The division of child development and early education for the state reported that there were 1,672 child care centers throughout the state with four- or five-star licenses (NCDHHS, 2015).

> The law defines child care as: three or more children under 13 years of age receiving care from a non-relative, on a regular basis at least once a week for more than four hours per day but less than 24 hours. (NCDHHS, 2014, p. 1)

The setting for this study on preschool teachers' attitudes and beliefs toward science was preschool programs throughout the selected state.

Sampling and Sampling Procedures

The sampling strategy involved targeting a realistic population of preschool teachers in an eastern state. The sample population included Head Start preschool teachers, preschool teachers employed at four-star- and five-star-rated licensed childcare centers, and preschool teachers who accessed the North Carolina Association for the Education of Young Children (NCaeyc) on Facebook. Head Start organizational directors (n = 45) and childcare center directors (n = 1672) were contacted via email and asked only to disseminate an invitation to participate in research to their preschool teachers. Notification of the research study was posted on the NCaeyc Facebook page in order to recruit preschool teachers throughout the state. This sampling method allowed for direct contact of preschool teachers via Head Start organizations, child care center directors, and access to the broader preschool teacher population through NCaeyc on Facebook.

To meet eligibility criteria for the survey-questionnaire, individuals needed to be preschool teachers working with 3-year-olds or 4-year-olds within the selected state. Due to the makeup of preschool classrooms, some of the children taught may have been 5-year-olds. The preschool teachers could have been new to the field of early childhood education or experienced educators working with preschool-age children. Other characteristics of the sample included working in child care centers that were public, private, or Head Start facilities. Interested participants could be female or male and could have varying levels of education, including an early childhood credential; an associate's, bachelor's, master's, or doctoral degree in early childhood education; or the equivalent. The minimum requirement for preschool teachers in North Carolina is the state's early childhood credential or an equivalent 2-year degree related to early childhood. The Head Start requirement for preschool teachers is an associate, baccalaureate, or advanced degree in early childhood education. The actual sample size was determined by the number of preschool teachers accepting the invitation to participate in research.

Procedures for Recruitment, Participation, and Data Collection

Procedures for recruitment involved emailing an informational letter to Head Start directors throughout the selected state. Head Start directors who were willing to have preschool teachers participate replied to the email and requested the invitation to participate in research, which was disseminated to preschool teachers. Upon accessing the web-based survey link provided on the invitation, preschool teachers were provided with an informational letter and consent form. The consent form informed the preschool teachers that by accessing the survey, they indicated their consent. Other preschool teachers received an invitation to participate in the research study through information provided on the NCaeyc Facebook page. Interested individuals accessed the survey directly through a provided link. Child care center directors of four-star-rated and five-star-rated license facilities received an informational email and an invitation to participate in research to disseminate to their preschool teachers. Upon accessing the web-based survey link provided on the invitation, preschool teachers were provided with an informational letter and consent form. Implied consent was granted when participants continued on to answer the survey questionnaire.

Data collection occurred electronically as preschool teachers throughout the state consented to the research and completed the demographic section and P-TABS questionnaire following the link to Survey Monkey. Within the demographic section, preschool teachers identified the age group of the children they taught, the district for which they were employed, their education level, and their years of preschool teaching experience. Upon completion of the survey, participants exited the study with no follow-up procedures required.

Instrumentation and Operationalization of Constructs

The instrument selected for this study was the Preschool Teacher Attitudes and Beliefs Toward Science (P-TABS) questionnaire developed and validated by Maier et al. (2013). The self-report questionnaire was tested and validated with a group of 507 Head Start teachers in the state of Florida. The P-TABS is comprised of 35 items: 14 items addressing teacher comfort, 10 related to child benefit, seven associated with challenges, and four that do not specifically address identified factors (see Appendix A). Eleven of the items are negatively worded to prevent the likelihood of skewed response toward the positive. Each of the 35 items is scored using a 5-point Likert scale: *strongly disagree* = 1 point, *mildly disagree* = 2 points, *neutral* = 3 points, *mildly agree* = 4 points, and *strongly agree* = 5 points. The 11 negatively worded items on the P-TABS must be reversed for scoring; thus, *strongly disagree* = 5 points, *mildly disagree* = 4 points, *neutral* = 3 points, *mildly agree* = 2 points, and *strongly agree* = 1 point. Michelle Maier, one of the designers of the questionnaire, granted permission for the P-TABS to be used in this research study, including permission to use the questionnaire electronically (see Appendix B).

The P-TABS scores were applied to three factors: teacher comfort, child benefit, and challenges. These factors were established through item analysis and related to the theoretical framework for establishing primary teachers' attitudes toward science developed by van Aalderen-Smeets et al. (2012). The 14 items related to teacher comfort measured a teacher's enjoyment and comfort in planning and demonstrating science activities corresponding to affective states in the theoretical framework. The seven questions that related to the factor of challenges or perceived control from the theoretical framework reflected negative attitudes and beliefs toward science. The 10 questions identified as child benefit factors pertained to whether or not preschool teachers believed that science is developmentally appropriate and whether science-related activities help improve preschoolers' school-readiness skills corresponding to the cognitive aspects of the theoretical framework. The process required participants to complete the instrument by reading each of the 35 items on the questionnaire and indicating the degree to which they agreed or disagreed with the statement by marking the appropriate response on the electronic survey. Survey Monkey was the chosen online survey and questionnaire software.

The dependent variable for this study was preschool teachers' attitudes and beliefs toward science as measured by the self-report P-TABS. The independent variables used to analyze the data were the education level of the preschool teacher and the number of years of preschool teaching experience. The first variable addressed *Research Question 2*: What are the differences in attitudes and beliefs toward science based on the education level of the preschool teacher? The P-TABS data collected were analyzed based on the identified factors of teacher comfort, child benefit, and challenges and how these factors differ based on the education level of the preschool teacher. The variable of education level of the preschool teacher related to the fourth characteristic of teachers' beliefs states that knowledge and beliefs are related, as well as the fifth characteristic, beliefs are part of an integrated system that includes self, education, knowledge, and the students preschool educators teach (Fives & Buehl, 2012). The second variable, years of preschool teaching experience, pertained to the continuum bounded on one end by beliefs that are stable and resistant to change and on the other by beliefs that are dynamic and changeable based on experiences (Fives & Buehl, 2012). This variable addressed *Research Question 3*: What are the differences in attitudes and beliefs toward science based on years of preschool teaching experience? The collected data were analyzed to describe preschool teachers' attitudes and beliefs regarding teacher comfort, child benefit, and challenges toward science.

Data Analysis Plan

Initial data analysis including frequency distributions and descriptive statistics was calculated using the analyze section of Survey Monkey. These results provided an overall view toward answering *Research Question 1*: What are the attitudes and beliefs of preschool teachers toward science? After establishing an overall view, further analysis quantified results related to the variable of the education level of the preschool teacher and the variable of years of preschool teaching experience.

The variable of the education level of preschool teachers was analyzed using nonparametric Mann-Whitney U test calculated using IBM Statistical Package for Social Sciences (SPSS) statistics software. Mann-Whitney U test was selected because it is used to identify differences between two ordinal variables: (a) teachers with a state credential or the equivalency option of an associate degree, thereby meeting minimum state requirements, and (b) teachers with a bachelor's degree or higher. This analysis was used to answer *Research Question 2*: What are the differences in attitudes and beliefs toward science based on the education level of the preschool teacher? The information was divided into the three identified factors: teacher comfort, child benefits, and challenges for interpretation of the results.

The second variable analyzed was years of preschool teaching experience. This variable was divided into three categories: (a) novice level with 3 years or less of preschool teaching experience, (b) intermediate level with 4 to 15 years of preschool teaching experience, and (c) advanced level with 16 or more years of preschool teaching experience. The rank-based nonparametric test used with IBS SPSS software is the Kruskal-Wallis H Test. The Kruskal-Wallis H test was used to describe differences between two or more groups: novice, intermediate, and advanced preschool teaching experience. The results were used to answer *Research Question 3*: What are the differences in attitudes and beliefs toward science based on years of preschool teaching experience? Once again, the information was divided into the identified factors: teacher comfort, child benefits, and challenges for interpretation of results.

Threats to Validity

P-TABS is a validated measurement that is used to gather preschool teachers' attitudes and beliefs toward science. Brenneman (2011) corroborated that P-TABS is a validated measurement used to gather teacher ideas related to science and science teaching after Maier, Greenfield, and Bulotsky-Sheared presented the initial validation of the P-TABS at the biennial meeting of the Society for Research in Child Development.

Results from the development and validation of the instrument showed that the P-TABS had an excellent overall internal consistency (Cronbach's alpha = .91; Maier et al., 2013). Factor analysis determined that Factor 1, teacher comfort (alpha of .89), and Factor 2, child benefits (alpha of .85), had internal consistency across all demographic groups: ethnicity, education, and experience. Factor 3, challenges (alpha of .71), lacked internal reliability across ethnicity and education groups (Maier et al., 2013). This could pose a threat to this study, as education was one of the variables. Another possible threat to validity is that preschool teachers' attitudes and beliefs may have been affected by recent science-related projects or trainings.

Ethical Procedures

Every reasonable precautionary measure was taken to secure the rights of the participants. Head Start organizational directors and four-star-rated and five-star-rated licensed childcare center directors disseminated a preschool teacher invitation to participate in research (see Appendix C). Upon accessing the survey through the provided Survey Monkey link on the invitation, the preschool teacher read a consent form outlining procedures, the voluntary nature of participation, the risks and benefits of the study, and the confidentiality of information collected. Implied consent was obtained as preschool teachers continued the survey after reading the consent form. Other preschool teachers received information about the research study through an invitation on the NCaeyc Facebook page. The consent form outlining procedures, the voluntary nature of participation, the risks and benefits of the study, and the confidentiality of information was provided upon participants accepting the invitation and accessing Survey Monkey.

Implied consent was acquired when participants continued on to the questionnaire. Due to implied consent and web-based surveying, participants have anonymity. Raw data collected via the computer through Survey Monkey. The raw data have been stored at my home address in a locked cabinet and will be retained for 5 years as required. The Institutional Review Board approved the application for the study entitled *Preschool Teachers' Attitudes and Beliefs Toward Science* on March 22, 2016, with the following approval number: 03-22-16-0366736.

My role as the researcher was to transfer the P-TABS questionnaire data to an electronic survey format using Survey Monkey. Upon participants' completion of the survey, I analyzed the collected data using the Survey Monkey "analyze results" section. I transferred data to IBM SPSS software and completed Mann-Whitney U tests and Kruskal-Wallis H tests to analyze the variables. I wrote up results of preschool teachers' attitudes and beliefs toward science in general and in relation to stated variables. I drew conclusions from the data collected in reference to preschool teachers' attitudes and beliefs toward science and the 12 districts with low science scores.

My professional role is that of an early childhood educator certified through the National Board of Professional Teaching Standards. I am employed as a kindergarten teacher with the Department of Defense Education Activity with the Fort Bragg district in North Carolina. Currently and in the past, I have not had any professional relationships with preschool teachers in the selected state. I currently do not work nor have I ever worked with the Head Start program within the selected state or the nation.

Summary

In this section, I have described the methodology chosen for the study of preschool teachers' attitudes and beliefs toward science. A quantitative descriptive comparative survey design using self-report (P-TABS) was the selected methodology. The participants included preschool teachers of 3-year-olds and 4-year-olds throughout the state. Data collection occurred after IRB approval and consisted of disseminating information to Head Start organizations and four-star-rated and five-star-rated licensed child care centers, as well as placing an invitation on the NCaeyc Facebook page. Data analysis included frequency distributions and descriptive statistics, Mann-Whitney U tests, and Kruskal-Wallis H tests. My expectation as the researcher was that I would identify the attitudes and beliefs of preschool teachers toward science. Researchers van Aalderen-Smeets and van der Molen (2015) found that "explicitly focusing on teachers' attitudes in professional development improves teachers' feeling of being in control over science teaching and their science related behavior" (p. 731). Positive social change may occur as a result of providing support and professional development in light of preschool teachers' attitudes and beliefs toward science. Preschool science standards address this crucial component of school readiness. Preschool teachers then use their acquired knowledge to facilitate science opportunities for early learners, and young children thereby form positive attitudes toward science, which represent an antecedent to positive assessment in science proficiency at the end of fifth grade. The results of participants completing the Preschool Teachers' Attitudes and Beliefs Toward Science questionnaire are shared in the next section.

Chapter 4: Results

Section 4 presents the findings of this study. The purpose of this descriptive comparative survey was to identify preschool teachers' attitudes and beliefs toward science. The section begins with a review of the data collection instrument followed by the demographic characteristics of the sample. Next, the results for *Research Question 1* (What are the attitudes and beliefs of preschool teachers toward science?) are discussed. This is followed by *Research Question 2* (What are the differences in attitudes and beliefs toward science based on the education level of the preschool teacher?) and *Research Question 3* (What are the differences in attitudes and beliefs toward science based on years of preschool teaching experience?). The survey results were used to describe preschool teachers' attitudes and beliefs toward science based on education level and teaching experience in relation to three identified factors: teacher comfort, child benefit, and challenges.

Data Collection and Analysis of Findings

Data were collected via Survey Monkey, with a link provided to participants on the invitation to participate in research. Upon completion of data collection, data were entered into IBM SPSS Statistics software version 21.0 for Windows for analysis following statistical tutorials (Laerd Statistics, 2015c). Descriptive statistics were used to describe participants' overall attitudes and beliefs toward science. The IBM SPSS software was used to run the nonparametric Mann-Whitney U (Laerd Statistics, 2015b) analysis to describe differences in the ordinal variable of education level. Kruskal-Wallis

H (Laerd Statistics, 2015a) nonparametric test was calculated with IBM SPSS to describe differences in the categorical variable of the years of preschool teaching experience.

Instrumentation

The data collection instrument for this study was the Preschool Teachers' Attitudes and Beliefs Toward Science Teaching (P-TABS) questionnaire (Maier et al., 2013). This self-report measure was developed using a group of Florida Head Start teachers. Permission was granted by Michelle Maier, one of the designers, for me to use the P-TABS and retype it into the website for Survey Monkey, a web-based survey agency (see Appendix B). A demographic section was added to gather data related to the preschool teachers' position: age group taught, district, education level, and years of preschool teaching experience.

Setting and Sample

An invitation for preschool teachers to participate in the research study was emailed throughout one eastern state with the goal of one teacher per center agreeing to participate in the research. Originally, an informational letter was emailed to 45 Head Start organization directors on March 22, 2016. Four directors replied to the email requesting the invitation to disseminate to their preschool teachers. The invitation was shared with educators, and preschool teachers (n = 28) completed the survey, with this group representing 58.30% of the total survey participants. Next, the invitation was posted on the NCaeyc Facebook page; however, no surveys were completed via this invitation. In order to acquire more participation, an IRB revision was granted on May 5, 2016, to email four-star and five-star licensed child care centers throughout the selected state, a total of 1,627. Childcare center directors were emailed throughout the month of May 2016. In total, 715 emails were sent to four-star licensed centers and 912 were sent to five-star licensed centers. Of those emails, 146 were returned as undeliverable, resulting in 1,481 emails sent to childcare center directors throughout the state. This resulted in preschool teachers *(n* = 20) completing the survey, with this group representing 41.7% of total survey participants. Data were collected via Survey Monkey from March 25, 2016 through June 6, 2016.

The preschool teacher participants *(N* = 48) who completed the survey answered the first demographic question by listing the following age groups taught: 3-year-olds *(n* = 5, 10.40%), 3- to 4-year-olds *(n* = 8, 16.70%), 3- to 5-year-olds *(n* = 8, 16.70%), 4-year-olds *(n* = 5, 10.40%), 4- and 5-year-olds *(n* = 20, 41.60%), and birth to 12 *(n* = 1, 2.10%). One participant chose not to answer *(n* = 1, 2.10%). Frequencies and percentages for the age group taught are presented in Table 1.

Table 1

Age Group Taught

Listed age group being taught	*n*	%
3-year-olds	5	10.4
3- to 4-year-olds	8	16.7
3- to 5-year-olds	8	16.7
4-year-olds	5	10.4
4- and 5-year-olds	20	41.6
Birth to 12	1	2.1
Chose not to answer	1	2.1

The largest group of participants was preschool teachers who taught 4- and 5-year-olds.

The second demographic question asked participants to share the district in which they taught. Within the selected state, there are 100 county-wide districts and 15 city districts. The participants represented 12 districts. The frequencies and percentages of the counties represented are listed in Table 2. These data were used to address the local problem of fifth graders' low proficiency on their end-of-grade science test. Early childhood educators' attitudes and beliefs guide their behavior in the classroom, determining what is shared with young children, including the establishment of a science foundation for science understanding in the later grades (Aldemir & Kermani, 2014; Morrison, 2012; Tao et al., 2012).

Table 2

Counties Represented in Survey

Counties listed by participants	*n*	%
Alamance/Burlington	1	2.08
Ashe	2	4.20
Buncombe	3	6.25
Catawba	1	2.08
Charlotte/Mecklenburg	20	41.60
Forsyth	1	2.08
Harnett	1	2.08
Orange	2	4.20
Pender	6	12.50
Wake	3	6.25
Watauga	1	2.08
Wilkes	1	2.08
North Carolina	3	6.25
Chose not to answer	3	6.25

The city of Charlotte within Mecklenburg County had the largest representation of participants (n = 20, 41.6%), as indicated by responses to the demographic question regarding the district in which the preschool teacher was employed. Six participants represented Pender County, while the remaining counties had three or fewer participants.

The third demographic question asked the participants to share their education level. Of the preschool teachers participating, 18 (37.5%) had the state credential or the equivalency option of an associate degree, the minimum state requirements. The remainder *(n* = 30, 62.5%) had a bachelor's degree or higher. Frequencies and percentages for preschool teachers' education level are presented in Table 3. The ordinal variables (credential or associate's degree and bachelor's degree or higher) and the identified factors of the P-TABS (teacher comfort, child benefit, and challenges) were analyzed using Mann-Whitney U tests, nonparametric tests to compare differences between two groups. Analysis of the data described differences in attitudes and beliefs toward science based on the education level of the preschool teacher, answering *Research Question 2.*

Table 3

Education Level

Selected highest education level	*n*	%
State credential and/or associate's degree	18	37.50
Bachelor's degree or higher	30	62.50

Preschool teachers with bachelor's degrees or higher represented almost two-thirds of participants. The remaining third were preschool teachers with a state credential or an associate's degree.

The final demographic question asked the participants to share their years of preschool teaching experience. Of all participants, eight (16.66%) were novice teachers with less than 3 years of preschool teaching experience; 18 (37.50%) classified themselves as intermediate, with between 4 and 15 years of preschool teaching experience; and 22 (45.83%) were classified as advanced with 16 or more years of preschool teaching experience. Frequencies and percentages of years of preschool teaching experience are presented in Table 4. The categorical variables (novice, intermediate, and advanced years of preschool teaching) and the identified factors of the P-TABS (teacher comfort, child benefit, and challenges) were analyzed using Kruskal-Wallis H tests, rank-based nonparametric tests to describe differences between two or more groups. An analysis of the data identified preschool teachers' attitudes and beliefs toward science based on the years of preschool teaching experience of the participants answering *Research Question 3*.

Table 4

Preschool Teaching Experience

Selected years of preschool teaching experience	*n*	%
Novice	8	16.66
Intermediate	18	37.50
Advanced	22	45.83

Preschool teachers with 16 years or more of preschool teaching experience represented the largest population of participants. The novice group, preschool teachers with less than 3 years of preschool teaching experience, represented the smallest population of participants.

Research Question 1: Results

Research Question 1 was as follows: What are the attitudes and beliefs of preschool teachers toward science? The data were disaggregated by the three identified factors: teacher comfort, child benefit, and challenges. Teacher comfort was comprised of 14 survey items that measured a teacher's enjoyment and comfort in planning and demonstrating science activities. Table 5 depicts the data for the identified factor of teacher comfort. All data were calculated on 48 preschool teacher participants accounting for missing responses.

Six of the teacher comfort items dealt directly with feeling comfortable in planning and demonstrating physical, life, and earth science as well as enjoying science. The range for these items was 50% to 72.92% for *strongly agree*. This data relates to the notion of self-efficacy that if one feels comfortable the more likely they will believe in their ability, in this case their ability to teach science (Bandura, 1977; Bautista, 2011). According to the data, almost two-thirds *(n* = 29, 60.42%) of the participants *strongly agreed* they get ideas for hands-on activities from what their preschoolers do, say, and ask. Gathering science ideas by watching and listening to preschoolers is an effective strategy to enhance young children's ability to grasp science concepts as activities build upon their interest and curiosity (Edson, 2013; Hyson & Tomlinson, 2014). Further, Mohrbacher (2015) states preschool teachers who engage in science talks with young children, draw out their ideas which lead to science investigations.

Table 5

P-TABS Items Related to the Identified Factor of Teacher Comfort

	Likert response				
Teacher comfort statement	Strongly disagree *n*, %	Mildly disagree *n*, %	Neutral *n*, %	Mildly agree *n*, %	Strongly agree *n*, %
I feel comfortable planning & demonstrating classroom activities related to physical & energy science topics.	1, 2.08	3, 6.25	6, 12.50	14, 29.17	24, 50.00
I discuss ideas & issues of science teaching with other teachers.	2, 4.17	6, 12.77	12, 25.00	13, 27.08	14, 29.16
I use all kinds of classroom materials (e.g., blocks, toys, boxes) for science activities.	2, 4.17	1, 2.08	6, 12.50	14, 29.17	25, 52.08
I use resource books to get ideas about science activities for young children.	2, 4.17	3, 6.25	3, 6.25	17, 35.42	22, 45.83
I feel comfortable doing science activities in my early childhood classroom.	2, 4.17	1, 2.08	3, 6.25	14, 29.17	27, 56.25
I feel comfortable planning & demonstrating classroom activities related to life science topics (e.g., plants, animals).	2, 4.17	1, 2.08	2, 4.17	12, 25.00	30, 62.50
I use the internet to get ideas about science activities for young children.	4, 8.33	0, 0.00	2, 4.17	9, 18.75	32, 66.66
I get ideas for hands-on activities from what my preschoolers do, say, and ask.	0, 0.00	2, 4.17	5, 10.42	10, 20.83	29, 60.42
I include some books about science during story time.	0, 0.00	1, 2.08	5, 10.42	14, 29.16	26, 54.16

(*table continues*)

Teacher comfort statement	Likert response Strongly disagree *n*, %	Mildly disagree *n*, %	Neutral *n*, %	Mildly agree *n*, %	Strongly agree *n*, %
I enjoy doing science activities with my preschool children.	0, 0.00	0, 0.00	1, 2.08	10, 20.83	35, 72.92
I demonstrate experimental procedures (e.g., comparing objects to see if they will sink or float) in my classroom.	0, 0.00	0, 0.00	2, 4.17	9, 18.75	35, 72.92
I make an effort to include some science activities throughout the week.	0, 0.00	0, 0.00	2, 4.17	14, 29.16	29, 60.42
I feel comfortable planning & demonstrating classroom activities related to earth science topics (e.g., sun, moon, stars).	1, 2.08	0, 0.00	1, 2.08	12, 25.00	31, 64.58
I collect materials and objects to use in my science teaching.	0, 0.00	2, 4.17	1, 2.08	13, 27.08	29, 60.42

The second identified factor was child benefit. There are 10 items on the P-TABS survey that examine whether or not preschool teachers believe that science is developmentally appropriate and whether science-related activities help to improve preschoolers' school readiness skills. Table 6 provides the 10 items that comprised the child benefit factors on the P-TABS with the Likert scale response. All data were calculated on 48 preschool teacher participants, accounting for missing responses.

Table 6

P-TABS Items Related to the Identified Factor of Child Benefit

Child benefit statement	Likert response Strongly disagree *n*, %	 Mildly disagree *n*, %	 Neutral *n*, %	 Mildly agree *n*, %	 Strongly agree *n*, %
Preschool science activities help foster children's interest in science in later grades.	2, 4.17	1, 2.08	0, 0.00	10, 20.83	35, 72.92
More science should be taught in the early childhood classroom.	2, 4.17	1, 2.08	3, 6.25	9, 18.75	33, 68.75
Experimenting hands-on with materials & objects is how young children learn best.	3, 6.25	0, 0.00	0, 0.00	5, 10.42	40, 83.33
Science-related activities help improve preschoolers' approaches to learning.	2, 4.17	1, 2.08	1, 2.08	12, 25.00	32, 66.66
Science-related activities help improve preschoolers' language skills.	2, 4.17	0, 0.00	5, 10.42	12, 25.00	29, 60.42
Science-related activities help improve preschoolers' math skills.	2, 4.17	1, 2.08	2, 4.17	12, 25.00	30, 62.50
Young children cannot learn science until they are able to read.	44, 91.66	2, 4.17	1, 2.08	0, 0.00	0, 0.00
Science-related activities help improve preschoolers' social skills.	0, 0.00	0, 0.00	3, 6.25	15, 31.25	28, 58.33
Science-related activities are too difficult for young children.	34, 70.83	7, 14.58	4, 8.33	0, 0.00	0, 0.00
Young children are curious about scientific concepts & phenomena.	0, 0.00	1, 2.08	0, 0.00	8, 16.66	36,75.00

The child benefit factor of young children improving preschoolers' readiness skills was supported by participating preschool teachers who selected *strongly agree* which resulted in 58% or more for each of the four related items. Many researchers agree that young children improve approaches to learning (Edson, 2013; Morrison, 2012), language skills (Gerde et al., 2013; Patrick et al., 2013), math skills (Ogu & Schmidt, 2013; Howitt et al., 2011), and social skills (Spektor-Levy et al., 2013; Tank et al., 2013; Torquati et al., 2013) while participating in science activities. The other part of the child benefit factor is related to whether science in early childhood is seen as developmentally appropriate. The collected data showed that preschool teachers *(n* = 44, 91.66%) *strongly disagree* that young children cannot learn science and *(n* = 34, 70.83%) of participants *strongly disagree* that science related activities are too difficult for young children. In the positive realm, (*n* = 35, 72.92%) of participating preschool teachers *strongly agree* that preschool science fosters science in later grades while *(n* = 33, 68.75%) believe more science should be taught in preschool.

The final factor identified using the P-TABS was challenges to early childhood science. The seven statements that related to the factor of challenges reflect negative attitudes and beliefs toward science. The seven survey items with Likert responses are provided in Table 7. All data was calculated on (*N* = 48) preschool teacher participants' accounting for missing responses.

Table 7

P-TABS Items Related to the Identified Factor of Challenges

Challenges statement	Likert response Strongly disagree *n*, %	 Mildly disagree *n*, %	 Neutral *n*, %	 Mildly agree *n*, %	 Strongly agree *n*, %
I do not have enough scientific knowledge to teach science to young children.	30, 62.50	8, 16.66	7, 14.58	2, 4.17	0, 0.00
I feel uncomfortable talking with young children about the scientific method (e.g., making hypotheses, predicting, experimenting).	36, 75.00	4, 8.33	1, 2.08	3, 6.25	3, 6.25
Given other demands, there is not enough time in a day to teach science.	24, 50.00	8, 16.66	1, 2.08	11, 22.92	2, 4.17
Preparation for science teaching takes more time than other subject areas.	21, 43.75	10, 20.83	5, 10.42	8, 16.66	2, 4.17
I am afraid that children may ask me a question about scientific principles or phenomena that I cannot answer.	29, 60.42	7, 14.58	6, 12.50	3, 6.25	1, 2.08
Planning and demonstrating hands-on science activities is a difficult task.	27, 56.25	6, 12.50	7, 14.58	6, 12.50	0, 0.00
I do not have enough materials to do science activities.	22, 45.83	6, 12.50	10, 20.83	7, 14.58	1, 2.08

The survey data collected from preschool teachers in one eastern state revealed that almost two-thirds of the participants *(n* = 30, 62.50%) *strongly disagree* with the item that states "I do not have enough scientific knowledge to teach science to young children." This result opposes the idea that a challenge preschool teachers might encounter is a lack of science content knowledge as identified by DeJarnette (2012). Other challenges identified in this research include resources of time and materials (Tank et al., 2013). Only (*n* = 2, 4.17%) participants felt there is not enough time for science and science preparation takes more time than other subject areas. In relation to materials, *(n* = 1, 2.08%) believed they did not have enough materials to do science activities.

One item on the P-TABS questionnaire that was not specifically addressed in the identified factors related to the appropriateness of introducing science to young children. Forty participants *(n* = 40, 83.33%) *strongly disagree* with the idea that science is not appropriate and one participant *(n* = 1, 2.08%) *strongly agreed* with this idea. Table 8 presents the full survey results for *(N* = 48) preschool teacher participants' accounting for the missing responses.

Table 8

P-TABS Item Not Included With Identified Factors

	Likert response				
Statement not included identified factors	Strongly disagree *n*, %	Mildly disagree *n*, %	Neutral *n*, %	Mildly agree *n*, %	Strongly agree *n*, %
It is not appropriate to introduce science to children at an early age.	40, 83.33	2, 4.17	3, 6.25	1, 2.08	1, 2.08

The information in Table 8 corroborates Merino's et al., (2014) study suggesting preschool teachers believe that scientific education, which fosters scientific literacy, should begin in the early years, age two to six.

Research Question 2: Results

Research question 2: What are the differences in attitudes and beliefs toward science based on the education level of the preschool teacher? Nonparametric Mann-Whitney U tests were run to describe differences in attitudes and beliefs based on the education levels (state credential or associate degree and bachelor or higher degree) and each identified factor (teacher comfort, child benefit, and challenges). Prior to running the nonparametric Mann-Whitney U test, a teacher comfort score was achieved for each participant by totaling their 14 scores related to their Likert response based on the appropriated P-TABS items and used as the dependent variable. The independent variable was the education level. The analysis showed that the distribution of teacher comfort scores for each group were similar, as assessed by visual inspection of the population pyramid produced by SPSS Statistics' nonparametric test procedure. The mean score for preschool teachers with the state credential or an associate degree was 61.1667 with the standard of error 2.06155. Preschool educators with a bachelor degree or higher had a mean score of 58.4333 with the standard error of 2.40962. Preschool teacher participants with a state credential or an associate degree were slightly more comfortable with attitudes and beliefs toward science than bachelor or higher degree participants.

Two more Mann-Whitney U tests were completed to describe differences between education level and the other two identified factors. First, a child benefit score was achieved by totaling the 10 related items responses for each participant. This score and the education level were analyzed using Mann-Whitney U test and showed the distribution of child benefit scores for each group were similar, as assessed by visual inspection. The mean scores for each group were similar, *(M* = 45.444) for state credential or associate degree and *(M* = 44.36670) for bachelor or higher degree preschool educators. The standard error of mean were 1.17496 and 1.58258 respectively. The results showed participants believe that children receive benefits from early childhood science.

Second, a challenges score was achieved by totaling the seven related P-TABS items responses for each participant. These seven items were negatively worded to prevent the likelihood of skewed response toward the positive thus the items were reversed for scoring. A third Mann-Whitney U test was run with the dependent variable of the challenge scores and the independent variable of education level. Once again the distribution of challenge scores for each group was similar, as assessed by visual inspection. State credential and associate degree participants' data resulted in a mean score of 28.1111 with a standard error of mean 1.17496 while the bachelor and higher degree participants mean score was 29.1379 with a standard of error of mean 0.93076. The group of participants *(N* = 48) perceived minimal challenges toward science according to the data.

Research Question 2 examined beliefs related to professional knowledge referring to an individual's formal academic training. Friesen and Butera (2012) determined that professional knowledge had a limited role in an educator's instructional decisions. This research supports their finding as on average minimal differences occurred between preschool educators with the state credential or associate degree and those with a bachelor or higher degree in their attitudes and beliefs toward science. This research parallels Cheung and Leung (2013) who found that preschool teachers' beliefs of creative pedagogy were similar with or without a degree.

Research Question 3: Results

Research Question 3: What are the differences in attitudes and beliefs toward science based on the years of preschool teaching experience? The independent variable, years of preschool teaching experience was divided into novice level with three or less years' experience *(n* = 8, 16.67%), intermediate level with four to 15 years' experience *(n* = 18, 37.50%), and advanced level with 16 or more years' experience *(n* = 22, 45.83%) for the categorical groups. Nonparametric Kruskal-Wallis H tests were conducted using IBM SPSS software calculating case summaries using mean for comparison.

Three Kruskal-Wallis H tests were conducted to analyze the factors of teacher comfort, child benefit, and challenges with the years of preschool teaching experience. Each factor score, teacher comfort with 14 items, child benefit with 10 items, and challenges with seven items, was achieved by totaling the number of related items responses for each participant. The mean scores with standard error of mean are displayed in Table 9.

Table 9

Kruskal-Wallis H Test Results Mean Scores and Standard Error

Years of teaching experience		P-TABS identified factors		
		Teacher comfort	Child benefit	Challenges
Novice	*M*	55.1250	41.2500	26.8750
	SE	3.81462	3.21686	1.90336
Intermediate	*M*	56.5556	43.7222	27.5294
	SE	3.46902	2.03210	1.33702
Advanced	*M*	63.4091	46.9091	30.3636
	SE	1.67184	1.09289	1.33702

The data collected from the three Kruskal-Wallis H test of preschool teachers' attitudes and beliefs toward science show that on average the preschool educator's participants with advanced experience have greater teacher comfort with science. Novice, intermediate, and advanced preschool educators shared attitudes and beliefs that early childhood science is beneficial to children. The novice group of educators perceive more challenges toward science as this item is reversed due to the negative wording of the items and the lower the number the more agreement.

Research Question 3 examined beliefs related to practical knowledge referring to individual experiences in instructing young children in science. Friesen and Butera (2012) determined that practical knowledge had a large influence on instructional decisions in the classroom. The current research determined that experience has a minimum impact on preschool teachers' attitudes and beliefs toward science. However minimal, the results established that preschool teachers with more experience are more comfortable, believe children receive benefits, and that challenges are surmountable. These results are supported by Sundberg and Ottander's (2013) research which determined that attitudes of preservice preschool teachers grew with experience, building competence, and confidence toward science.

Summary

The outcomes of this study have been presented, summarized, and interpreted in relation to the three research questions. The descriptive data revealed (*n* = 18, 37.50%) of the preschool teacher participants have state credentials or associate degree while (*n* = 30, 62.50%) of the participants have a bachelor degree or higher. The years of preschool teaching experience varied from (*n* = 8, 16.66%) for novice teacher, (*n* = 18, 37.50%) for intermediate teacher, and (*n* = 22, 45.83%) for advanced teacher. The preschool teacher participants completed the P-TABS questionnaire which has three identified factors: teacher comfort, child benefit, and challenges.

Research Question 1 asked what are the attitudes and beliefs of preschool teachers toward science. The survey results collected and analyzed using Survey Monkey revealed that in general 57.74% of preschool teacher participants *strongly agree* with statements that addressed the identified factor of teacher comfort measuring teachers' enjoyment and comfort in planning and demonstrating science activities. The second factor, child benefit measured the notion that early childhood science is developmentally appropriate and children improve school readiness skills. This factor measured an even greater agreement between participants with 71.04% selecting *strongly agree* for the statements addressing child benefit. The third factor, challenges relating to negative attitudes and beliefs, determined that majority, 56.25% participants selected *strongly disagree* meaning that challenges were limited or overcome.

The data collected relating to *Research Question 2* were analyzed to describe differences with preschool teachers' attitudes and beliefs based on their education level. Mann-Whitney U tests were conducted for each of the factors and education level. The results showed preschool teachers with a state credential or an associate degree had slightly more comfortable attitudes and beliefs toward science. Both groups reported believing children receive benefits from science and that challenges are limited.

The final research question focused on the attitudes and beliefs toward science based on the years of preschool teaching experience. Analysis of the data using Kruskal-Wallis H tests showed preschool teachers with advanced experience had greater teacher comfort toward science. Each grouping of participants' perceived child benefits with science. The novice group of preschool teacher participants perceived slightly more challenges toward science. Overall, the results showed preschool teacher participants (n = 48) have positive attitudes and beliefs toward science and that early childhood science is appropriate in the early childhood classroom. Section 5 provides discussion, conclusions, and recommendations from the research on preschool teachers' attitudes and beliefs toward science.

Chapter 5: Discussion, Conclusions, and Recommendations

This research study was conducted to investigate preschool teachers' attitudes and beliefs toward science. Early childhood educators' attitudes and beliefs guide their behavior in the classroom, determining what is shared with young children. Science opportunities in the preschool years lay a foundation for science in later grades and for science, technology, engineering, and math (STEM) careers needed in the 21^{st} century. The data collected were analyzed to determine an overall view of science in early childhood settings. Additionally, the relationship of attitudes and beliefs in regard to education level and years of preschool teaching experience was described. The descriptive comparative survey was conducted in one eastern state using an online survey site. The population of interest was teachers working with preschoolers in 2016. An invitation to participate in a research study was emailed to Head Start organizational directors and childcare center directors of four-star and five-star licensed facilities and was posted on the North Carolina Association for the Education of Young Children's (NCaeyc) Facebook page. Data collection commenced upon approval from Walden University's Instructional Review Board (IRB) and the selection of participants.

The participants were primarily asked to answer questions dealing with their attitudes and beliefs toward science and basic demographic information. The demographic information revealed that the preschool teacher participants (n = 48) taught 3-, 4-, and 5-year-olds and combinations thereof within the preschool setting, while one teacher worked with children from birth through age 12. The combination of 4- and 5-year-olds encompassed the largest group of participants (n = 20, 41.6%). The total group of participants ($N = 48$) represented 12 districts within the selected eastern state. In terms of education level, 18 participants (37.50%) held a state credential or an associate's degree. The remainder ($n = 30$, 62.5%) held a bachelor's degree or higher. The years of preschool teaching experience varied for the participants: Eight (16.66%) were novice teachers with less than 3 years of preschool teaching experience, 18 (37.50%) were intermediate teachers with between 4 and 15 years of preschool teaching experience, and 22 (45.83%) were advanced, with 16 or more years of preschool teaching experience.

Key Findings

The purpose of *Research Question 1* (RQ1) was to identify preschool teachers' attitudes and beliefs toward science disaggregated by the three identified factors on the Preschool Teacher Attitudes and Beliefs Toward Science (P-TABS) questionnaire: teacher comfort, child benefit, and challenges. In relation to teacher comfort, 57.74% of the preschool teachers selected *strongly agree* when answering items related to feeling comfortable planning and demonstrating science and identifying resources for science teaching. The child benefit factor addressed issues related to the appropriateness of science and the improvement of young children's school readiness skills. Almost three-fourths (71.04%) of the preschool teachers expressed attitudes and beliefs that science in the early childhood classroom benefits young children and is developmentally appropriate. For the final factor, challenges, questionnaire statements were worded negatively to prevent P-TABS results from being skewed to the positive. The items related to discomfort and difficulties in teaching science with young children as well as lack of resources for teaching science. Just over half of the participants (56.25%) strongly disagreed with the statements related to the challenges factor.

In reflecting on the results, as an advocate for early childhood science instruction, I was pleased to learn that the majority of participants believed that early childhood science is developmentally appropriate and that young children improve school readiness skills as a result of science activities—the child benefit factor. The teacher comfort factor and challenges factor differed by only 2.38%, which leads me to believe that the two factors are closely related. As individuals build their self-efficacy, their comfort level with teaching science to young children increases, and challenges are no longer seen as unsurmountable.

The other two research questions used the overall data and were analyzed with respect to the participants' education level and years of preschool teaching experience. *Research Question 2* (RQ2) specifically addressed the education level of the preschool teachers in regard to the identified factors. Nonparametric Mann-Whitney U tests were conducted to analyze the ordinal variable of education level: state credential or associate's degree and bachelor's degree or higher, of the participants with the P-TABS identified factors: teacher comfort, child benefit, and challenges and describe differences. The results showed that state credential or associate's degree preschool teachers had slightly more comfortable attitudes and beliefs toward science. Both groups reported believing that children receive benefits from science and that challenges are limited. This suggests that administrators and directors should consider factors beyond the education level of the preschool educator when employing individuals who are shaping the next generation.

Research Question 3 (RQ3) compared the participants' years of preschool teaching experience (novice with less than 3 years, intermediate with 4 to 15 years, and advanced with more than 16 years) with the three identified factors: teacher comfort, child benefit, and challenges. Nonparametric Kruskal-Wallis H tests were conducted, indicating that preschool teachers with advanced experience had greater teacher comfort toward science. This study supports previous research on preschool teacher candidates by Sundberg and Ottander (2013) and Timur (2012), which determined that positive attitudes grew and teaching science improved with experience. With experience, preschool teachers acquire knowledge of the skills that preschoolers learn. According to Edson (2013) and Morrison (2012), these preschool skills include observation, investigation, collaboration, communication, measurement, prediction, interpretation of information, and problem solving—skills that benefit children and are supported by preschool teacher participants ($N = 48$) of all experience levels. Those preschool educators with less experience perceived slightly more challenges toward science when analyzing results of the Kruskal-Wallis H test. These results support professional development that revolves around coplanning, coteaching, and coreflecting (Nilsson, 2015), pairing a novice preschool teacher with an advanced preschool teacher.

Interpretation of the Findings

In this section, I describe the research questions and interpret the findings based on conclusions from data analysis, referencing outcomes from Section 4. The information covers all of the data and is bounded by the evidence collected. The findings are cross-referenced with the literature reviewed in Section 2. The three research questions and practical applications are discussed regarding this research on preschool teachers' attitudes and beliefs toward science.

Research Question 1

RQ 1: What are the attitudes and beliefs of preschool teachers toward science?

The collected data revealed preschool teachers' attitudes and beliefs toward science based on three identified factors on the P-TABS: teacher comfort, child benefit, and challenges. The 14 items of the P-TABS related to teacher comfort (Table 5) revealed that 57.74% of the participants were comfortable teaching science. Further analysis of the data by selected items showed that 35 (72.92%) of the teachers enjoyed doing science activities with their preschool students, with the following comfortability by content area: earth science (n = 31, 64.58%), life science (n = 30, 62.50%), and physical science (n = 24, 50.0%). The participants got their ideas for science activities from the Internet (n = 32, 66.66%) and from what preschoolers did, said, and asked (n = 29, 60.42%). An effective strategy for enhancing young children's ability to grasp science concepts (discussed in the literature review) is building upon children's interest and capturing the unexpected (Andersson & Gullberg, 2014); creating "that teachable moment." Administrators and directors can use this information to provide effective professional development for preschool teachers. The data revealed that these participants enjoyed teaching science but that physical science was an area of weakness and a topic that could be addressed through professional development. This data depicted the importance of capturing the moment; in order for that to be effective, administrators and directors have to allow their preschool teachers flexibility to address students' interests, not just follow the curriculum.

The second identified factor was child benefit. This factor refers to the improvement of school readiness skills and the developmental appropriateness of science in the early childhood classroom (Table 6). Nearly three-fourths (71.04%) of the participants indicated that science activities in the early childhood classroom benefit young children. Researchers Hollingsworth and Winter (2013) stated that social-emotional skills are more important than cognitive skills. Contradictory results were revealed in this research. The participants believed that science-related activities help improve preschoolers' approaches to learning (n = 32, 66.66%), improve language skills (n = 29, 60.42%), and improve math skills (n = 30, 62.50%), whereas results for improvement of social skills were n = 28 (58.33%). This study supports previous research indicating that preschoolers are naturally curious and have a sense of wonder (Dominguez et al., 2013; Erden & Sonmez, 2011; Howitt et al., 2011), as 80%, or 36 out of 48 participants, strongly agreed with the statement that young children are curious about scientific concepts and phenomena. For young children to reap the benefits of science, administrators and directors need to provide an environment in which preschool teachers willingly engage young children in science concepts.

Challenges to early childhood science represented the third factor and related to not having science knowledge or being comfortable with science and lacking resources. The seven items (Table 7) were worded negatively, and results showed that over half of the participants (56.25%) strongly disagreed with the statements. If one compares *strongly disagree* and *mildly disagree* (70.83%) with *mildly agree* and *strongly agree* (14.59%) responses, it is apparent that the majority of the preschool teachers believed that challenges are minimal in early childhood science. The P-TABS item that had the lowest percentage of *strongly disagree* responses was the statement that preparation for science teaching takes more time than other subject areas (n = 21, 43.75%). This is supported by literature. Tank et al. (2013) found that preparing for science investigations and carrying out investigations are challenging due to the amount of time involved. Administrators and directors can apply this knowledge by providing extra time and support for preschool teachers to collaborate and plan science activities.

Research Question 2

RQ 2: What are the differences in attitudes and beliefs toward science based on the education level of the preschool teacher?

The preschool teachers identified their education level as either state credential or associate's degree (n = 18, 37.50%) or bachelor's degree or higher (n = 30, 62.5%), as exhibited in Table 3. The nonparametric Mann-Whitney U test was utilized to quantify the differences between two ordinal variables and the three identified factors: teacher comfort, child benefit, and challenges. The results showed that the mean data are similar for each factor based on the education level of the preschool teacher participants. Administrators and directors can use this information when evaluating candidates for employment, realizing that education level is just one of the many facets that should be considered.

Research Question 3

RQ 3: What are the differences in attitudes and beliefs toward science based on years of preschool teaching experience?

Years of preschool teaching experience were divided into three categories: novice level, with 3 years or less of preschool teaching experience; intermediate level, with 4 to 15 years of preschool teaching experience; and advanced level, with 16 or more years of preschool teaching experience, presented in Table 4. The rank-based nonparametric test (Kruskal-Wallis H) was chosen for describing differences between two or more groups: novice, intermediate, and advanced level of preschool teaching experience. The results of the conducted Kruskal-Wallis H tests showed the distribution of identified factors (teacher comfort, child benefits, and challenges) were similar across the categories of years of preschool teaching experience. Research (discussed in the literature review) established that in most cases, experience does have an influence on attitudes and beliefs as well as instructional decisions and improvement in teaching science to young children (Friesen & Butera, 2012; Mintzes et al., 2013; Sundberg & Ottander, 2013). This information can be used by administrators and directors when placing teachers together to work with one age group of children, as a more experienced teacher can provide guidance and comfort to a less experienced teacher.

Demographic Findings

The age groups that the preschool-educator participants represented in this study were 3-year-olds to 5-year-olds, depending upon the makeup of the preschool class. The districts represented by the participants in this research were not the districts represented in the local problem, even though the invitation to participate in research was sent statewide. The range for the district scores represented by participants was 56.7% to 74.8% for fifth graders proficient on end-of-grade science test, whereas the range for the districts for the local problem was 21.4% to 56.5% (School Report Cards, 2013-2014). One of the districts represented has a Tier 1 designation from the state department of commerce, which means that it is one of 40 most distressed counties for economic well-being in the state (NC Commerce, 2015). This western county district score was 74.8% for fifth graders proficient on the end-of-grade science test. This leaves me to speculate that including science in early childhood programs may make a difference for future science achievement.

The practical application of this research on preschool teachers' attitudes and beliefs toward science is professional development. Professional development that addresses teachers' beliefs and builds scientific attitudes is the most effective (van Aalderen-Smeets & van der Molen, 2015). Specific to this research is professional development that enlightens preschool teachers that young children can grasp science concepts even if they are unable to read. One example is Marvelous Explorations Through Science and Stories (MESS), a free resource from the Early Childhood Learning and Knowledge Center (MESS, 2004). Appropriate professional development in relation to preschool teachers' years of experience involves preschool teachers building science confidence through coplanning, coteaching, and coreflecting (Nilsson, 2015) with an experienced preschool teacher who has the characteristics of a science champion: motivating, positive, and relaxed with science instruction (Mansfield & Woods-

McConney, 2012). This is accomplished through developing a network of early childhood professionals who can serve as science champions. Once a network is established, administrators and directors will have a means of locating early childhood professionals who can meet the needs of their preschool teachers.

Limitations of the Study

Three limitations to this study deserve attention. First, despite best efforts to recruit preschool teachers throughout the selected state, the sample population remained low. The amount of participation limits generalizability across all preschool teachers. The second limitation was the P-TABS, which is a self-report measure and may not reflect actual science practice in early childhood classrooms. A final limitation was the individual teachers' breadth and depth of science instructional knowledge. If the preschool teachers had been involved with a science-related project or training recently, this may have affected attitudes and beliefs toward science and thus the results.

Recommendation for Action

The practical application of this study involves providing preschool teachers with pragmatic experiences that build their comfort and knowledge levels in relation to science within the early childhood classroom. This can be accomplished by administrators and directors providing opportunities for preschool teachers to coplan, coteach, and coreflect on science activities within the early childhood setting. Opportunities should be provided for preschool teachers to view young children in child care settings successfully participating in science activities. This can be accomplished through observing within another classroom or through watching video lessons of young children involved in science activities. Young children are naturally curious, and this could be used as leverage for building science instruction in the classroom.

Early childhood educators and administrators or directors of preschool child care centers who pay attention to these results help build a science foundation which supports students' science improvement for future mandated fifth grade end of grade exam. This foundation can and should begin in early childhood classrooms where young children's sense of wonder and enthusiasm abounds. Administrators and directors of child care centers have the opportunity to provide effective professional development addressing the needs of preschool teachers based on their attitudes and beliefs. Other means of supporting preschool teachers is allowing for flexibility of the curriculum in order that teachers may capture the moment and children's curiosity. Administrators and directors need to provide an environment that promotes science and time for planning and collaborating between preschool teachers. The results of this study will be disseminated to Head Start organizations throughout the state and NCaeyc organization.

Recommendations for Further Study

One recommendation for further study would be replicating this research with a larger population. Although these findings are based on a small population and describe difference in attitudes and beliefs toward science based on education level or years of preschool teaching experience; a study with a larger population may produce different results. Preschool teachers' needs in relation to science in the early childhood classroom may be more obvious with a larger population thus pinpointing specific professional development needs.

A second recommendation for further study would be comparing preschool teachers' attitudes and beliefs toward science with actual science practices in the early childhood classroom. A longitudinal study with a group of children who receive effective science activities in the preschool classroom and their scores on the end of grade science exam in fifth grade would provide a unique opportunity for study. This study would be able to validate if teachers' attitudes, beliefs, and practices toward science in the early childhood classroom truly lays a foundation for science in the later grades. Science education in the early years is important for developing critical thinking skills and laying a foundation for science in future grades and in science careers.

Implications for Social Change

The purpose of this study was to ascertain preschool teachers' attitudes and beliefs toward science in one eastern state which determines whether or not science is seen as valuable for the early childhood classroom. The results revealed that preschool teachers do believe that preschool science activities help foster children's interest in science in later grades. This is meaningful as research has shown that science opportunities during the preschool years lay a foundation for elementary science (Aldemir & Kermani, 2014; Morrison, 2012; Tao et al., 2012). However, just over half of the participants stated they feel comfortable teaching science to young children. According to van Aalderen-Smeets et al. (2012), improvement of science education is the result of primary teachers developing positive attitudes toward science which relates to feeling more comfortable with science. This can be accomplished through professional development or teacher modeling that is effective, occurs in multiple contexts, and is of personal significance to the preschool teacher.

The National Science Teachers Association position statement on early childhood science education (2014) recommends that teachers receive quality professional experiences. Full recommendations are identified in the literature review. Preschool teachers provided with a science content instruction and collaboration with a science mentor, grounded in everyday activities, and experimentation over time (Rytivaara & Kershner, 2012), will increase their comfort level with science in the early childhood classroom. As preschool teachers increase their comfort level and knowledge of science in the early childhood classrooms they will facilitate more science opportunities for young children laying the foundation for science in later grades. Kelly (2015) reported preschool teachers with positive attitudes toward science tend to lead young children to develop positive attitudes toward science for future school years and possibly future science careers.

Conclusion

In April 2016, the White House, in partnership with the U. S. Departments of Education and Health and Human Services and Invest in US, hosted the event Advancing Active STEM Education for Our Youngest Learners (The White House, 2016). New steps to be taken by the administration related to science include: research grants to improve early elementary science outcomes; a new PBS series, *Splash and Bubbles*, focusing on marine biology sponsored by the Jim Henson Company; the Lawrence Hall of Science in partnership with a local community college is developing a course on teaching science and math to young children; and the National Science Teachers Association (NSTA) is creating streamlined array of resources known as *NSTA Initiative for Learners 0-5.* This initiative validates the importance of science as well as technology, engineering, and mathematics in the early childhood classroom. Items that directly address this research and professional development include the development of a course on teaching science to young children and ready access to a streamlined array of resources. The recommendation of a longitudinal study addresses the new initiative of research grants to improve early elementary science.

The expectation is that preschool teachers are trained professionals who recognized the importance of early learning across the five essential domains of school readiness: physical development and health; social and emotional development; approaches to learning; language and literacy; and cognitive and general knowledge which include science knowledge and skills (Head Start, 2015b). As professionals, early childhood educators create effective science-related opportunities for young children that improve preschoolers' approaches to learning: initiative and curiosity, persistence and attentiveness, and cooperation (Head Start, 2015b). In doing so, young children form positive attitudes toward science which is an antecedent to positive assessment in science proficiency at the end of fifth grade.

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Appendix A: P-TABS Questionnaire

Preschool Teacher Attitudes and Beliefs toward Science Questionnaire (P-TABS)

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters: **strongly disagree** (**SD**), **mildly disagree** (**MD**), **neutral** (**N**), **mildly agree** (**MA**), or **strongly agree** (**SA**).

		Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree
1.	Preschool science activities help foster children's interest in science in later grades.	SD	MD	N	MA	SA
2.	I feel comfortable planning and demonstrating classroom activities related to physical and energy science topics (e.g., force of gravity; gas, liquids, solids).	SD	MD	N	MA	SA
3.	More science should be taught in the early childhood classroom.	SD	MD	N	MA	SA
4.	It is important for my classroom to have a science area that can be freely explored by children.	SD	MD	N	MA	SA
5.	Given other demands, there is not enough time in a day to teach science.	SD	MD	N	MA	SA
6.	Experimenting hands-on with materials and objects is how young children learn best.	SD	MD	N	MA	SA
7.	Science-related activities help improve preschoolers' approaches to learning.	SD	MD	N	MA	SA
8.	I discuss ideas and issues of science teaching with other teachers.	SD	MD	N	MA	SA
9.	I use all kinds of classroom materials (e.g., blocks, toys, boxes) for science activities.	SD	MD	N	MA	SA
10.	Preparation for science teaching takes more time than other subject areas.	SD	MD	N	MA	SA
11.	I use resource books to get ideas about science activities for young children.	SD	MD	N	MA	SA
12.	I feel comfortable doing science activities in my early childhood classroom.	SD	MD	N	MA	SA
13.	I feel comfortable planning and demonstrating classroom activities related to life science topics (e.g. living things, plants, animals).	SD	MD	N	MA	SA
14.	Science-related activities help improve preschoolers' math skills.	SD	MD	N	MA	SA
15.	It is not appropriate to introduce science to children at an early age.	SD	MD	N	MA	SA
16.	Science-related activities help improve preschoolers' language skills.	SD	MD	N	MA	SA
17.	I do not have enough scientific knowledge to teach science to young children.	SD	MD	N	MA	SA

Preschool Teacher Attitudes and Beliefs toward Science Questionnaire *(continued)*

	Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree
18. I feel uncomfortable using scientific tools such as scales, rulers, and magnifying glasses when teaching science lessons.	SD	MD	N	MA	SA
19. I feel uncomfortable talking with young children about the scientific method (e.g., making hypotheses, predicting, experimenting).	SD	MD	N	MA	SA
20. I use the internet to get ideas about science activities for young children.	SD	MD	N	MA	SA
21. Young children cannot learn science until they are able to read.	SD	MD	N	MA	SA
22. I get ideas for hands-on activities from what my preschoolers do, say, and ask.	SD	MD	N	MA	SA
23. Science-related activities are too difficult for young children.	SD	MD	N	MA	SA
24. I include some books about science during storytime.	SD	MD	N	MA	SA
25. Science-related activities help improve preschoolers' social skills.	SD	MD	N	MA	SA
26. I enjoy doing science activities with my preschool children.	SD	MD	N	MA	SA
27. I am afraid that children may ask me a question about scientific principles or phenomena that I cannot answer.	SD	MD	N	MA	SA
28. I demonstrate experimental procedures (e.g., comparing objects to see if they will sink or float) in my classroom.	SD	MD	N	MA	SA
29. I do not mind the messiness created when doing hands-on science in my classroom.	SD	MD	N	MA	SA
30. Planning and demonstrating hands-on science activities is a difficult task.	SD	MD	N	MA	SA
31. Young children are curious about scientific concepts and phenomena.	SD	MD	N	MA	SA
32. I do not have enough materials to do science activities.	SD	MD	N	MA	SA
33. I make an effort to include some science activities throughout the week.	SD	MD	N	MA	SA
34. I feel comfortable planning and demonstrating classroom activities related to earth science topics (e.g., sun, moon, stars, weather).	SD	MD	N	MA	SA
35. I collect materials and objects to use in my science teaching.	SD	MD	N	MA	SA

Appendix B: Permission to Use P-TABS Questionnaire

Hi Sharon,
Thank you for the agreement. I'm attaching the questionnaire along with some instructions on how to score it (in SAS). Best of luck with your doctoral research. I look forward to hearing what you learn!
Best,
Michelle

Michelle Maier,
Thank you for granting permission to use P-TABS. Attached is a scan copy of the agreement as requested. A hard copy has been placed in the mail.
Sharon H. Lloyd

Hi Sharon,
I apologize for the delay in responding. I've been out of town at a conference.
Yes, you may use the P-TABS in your work. Please complete and return the attached form, and I can then send you the measure.
Best,
Michelle

Since the original agreement, I have been in contact with Michelle Maier and have received permission to use the P-TABS questionnaire with Survey Monkey.

Hi, Sharon,

Yes, you may use the P-TABS questionnaire with Survey Monkey. Electronic surveys certainly seems to be where data collection is going. I'd love to hear about whatever lessons you learn along the way in getting this to work in N.C.!

Best,
Michelle Maier

Appendix C: Invitation to Participate in Research

Preschool Teachers: Invitation to Participate in Research

Young children making sense of the world – Science in the early childhood setting.

To all preschool teachers of three year olds or four year olds:

Please consider participating in a research study: Preschool Teachers' Attitudes and Beliefs toward Science.

Your participation in this survey is voluntary and anonymous.

Child Care Center Directors were asked only to disseminate the information.

The survey consists of four demographic questions and a 35 item questionnaire. You will rank statements from strongly agree to strongly disagree.

If you have any questions or comments please feel free to contact me at Sharon.lloyd2@waldenu.edu

Please click the link below to go to the survey. The first screen will provide more information and give the option of participating or opting out.

Survey Link: https://www.surveymonkey.com/r/RXJP9X6