EXPLORING HEAD START TEACHERS' PERCEPTIONS OF SCIENCE IN PRESCHOOL EDUCATION

by

Taylor Brown

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Director of Thesis: Archana V. Hegde, PhD

Major Department: Human Development and Family Science

The lowest-performing learning domain, particularly among low-income families, has been identified as science education. Preschool science education has advantages that are well known, but more research is needed to understand how Head Start (HS) teachers use and view preschool science and how this impacts their teaching methods. Utilizing the constructs of phenomenology, thirty-five in-depth semi-structured telephone interviews were conducted with HS teachers from 16 counties across the three regions of North Carolina. Researchers identified significant statements through open coding which were categorized into themes informed by Expectancy Value Theory. Teachers reported several motivators (personal values, previous experiences, child engagement, etc.) and barriers (limited resources, perceived lack of support, competing domains, etc.) as they relate to science education. Most teachers expressed value for science in early years but many expressed hesitancies when approaching the subject. Implications of the findings for HS and the field of early childhood care and education have been discussed in greater detail.

Keywords: preschool science, Head Start, expectancy value theory, professional development, training, science resources, barriers, support

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Taylor Brown

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Director of Thesis: Archana V. Hegde, PhD
Thesis Committee Members:
Archana V. Hegde, PhD
Jacquelyn Kenann Mallette, PhD
Tammy Lee, PhD

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

This study investigates how Head Start teachers view science incorporation in early childhood classrooms, including their use of science resources and personal reflections. One can assess the efficacy of our current programs and investigate the possible need for further support by understanding the experiences of Head Start teachers through a study that is inclusive of the state of North Carolina. Established with the goal of combating poverty and educational disparities in low-income regions, Head Start now exists as the largest publicly funded program supporting preschool education for low-income communities. According to Bustamante et al. (2018), there is a national achievement gap between individuals of lower socioeconomic backgrounds and those from higher socioeconomic backgrounds. In order to provide support for affected populations, the constructs of Head Start strongly emphasize generating positive developmental experiences for children from low-income families. According to Sabol et al. (2019), this could ultimately bridge the identified achievement gap. Thus, the ultimate goal of Head Start education is to maximize the influence on students' developmental experiences and academic performance in the long run, which is best supported by quality evaluation and regulation among educators and regulations of Head Start programs (Sabol et al., 2019).

While research has indicated the need for more teacher quality evaluations overall, one particular area of curriculum warrants attention as programs are evaluated. Bustamante et al. (2018) touched on the existing gap within different subject areas and stated that science is found to be the lowest-performing subject within the school readiness domain, especially among low-income families. The importance of incorporating science in the preschool setting has been established as a result of the multitude of beneficial concepts that young children would be exposed to. Early incorporation of science has been of great importance to the development of children's scientific concepts and other areas of development (Kallery & Psillos, 2002). Additionally, Eshach & Fried (2005) found that early exposure to science helps kids develop more positive views toward the subject and a better understanding and foundation of the scientific issues they will later face.

However, while it seems that a subject as crucial as this should be implemented in early years, there is a lack of research surrounding practices that begin earlier than primary and secondary school. According to Andersson & Gullberg (2012), the advantages of the integration of science within the preschool classroom include but are not limited to children developing new understandings of their environment, motivating their interest in the processes of nature, supporting the expansion of vocabulary, and developing a genuinely inquisitive mindset. Thus, preschool teachers play an important role in supporting and providing young children with thorough and enriching science experiences within their respective classrooms.

Derived from existing literature, this study aimed to answer this fundamental research question: What experiences do Head Start educators have with preschool science education, and how does this affect their prevalence of incorporating preschool science curriculum? Potential theory and literature review were utilized to answer this overarching question. Thus, utilizing a phenomenological qualitative research design, this study closely examined Head Start preschool teachers' lived experiences with science education. Specifically looking at their current experiences with science teaching, opportunities for professional development, and their perceived need for support while introducing science in their preschool classrooms. One specific theory described below provides a robust framework for the study undertaken.

CHAPTER 2: THEORETICAL FRAMEWORK

When conducting research, one can approach a problem from a specific angle, which ultimately determines how one can recognize and connect the accessible components of the problem or condition. Each existing theory is distinct in its focus and perspective, providing frameworks through which academics might view circumstances. Bengtson (2006) recognizes that the process of theorizing involves acknowledging concepts that aid us in comprehending and interpreting our data. Taking this into account, the researcher's understanding, strategy, and recommended solution might be influenced by the theories they employ. The expectancy-value theory (EVT) proposed and employed by Abrami et al. (2004) to understand instructors' beliefs in connection to expectations, value, and costs when it comes to instruction forms the backbone of this study.

According to the EVT, people make decisions based on their expectations for success and the importance of the task. In this context, the practice of incorporating science into the classroom would be influenced by teachers' perceptions of the value of science as well as their level of comfort teaching it. This theory also emphasizes the fact that a variety of values, including intrinsic, attainment, utility, and cost values, influence how decisions are made (Kuhn et al., 2022). Intrinsic value refers to the personal joy that the individual experiences when completing the task. For teachers in this study, the intrinsic value would be reflected in how much they enjoy teaching science in the classroom. Attainment value measures how important an individual perceives the task to be, suggesting, teachers view on science and its related importance within a preschool curriculum, will determine whether teachers view science to be important for young children. The last value considered is utility value and focuses on the perceived usefulness of a task, suggesting that however useful teachers perceive science to be will influence their willingness to incorporate it in the classroom (Jud et al., 2023). In contrast, EVT also proposes that individuals take costs into consideration as well, examining the difficulties that exist when completing the task. This would include any barriers that teachers may face when implementing science lessons in the classroom.

Essentially, the framework of expectancy-value theory allows one to assess how teachers' beliefs and their professional environments relate to one another in order to better understand their teaching approaches (Thatcher Day, 2021). Using the framework of expectancy-value theory has the potential to reveal the importance of values and expectations in the implementation and efforts of educators (Green, 2002). Thus, the application of this theory may shed light on the motivations as well as hesitation experienced by Head Start teachers when incorporating science within the classroom due to their preexisting values and expectations. The next section delves into the need for science education and its relevance for young children in greater detail.

CHAPTER 3: LITERATURE REVIEW

Gap within Science, Technology, Engineering, and Math (STEM) Education

In the current workforce, reports have suggested that while women make up about half of the workforce in the United States and half of the workforce with college degrees, they remain disproportionately underrepresented in the fields of science, technology, engineering, and math (STEM), suggesting a prevailing gender achievement gap (Beede, 2011). In order to promote success and equality within STEM education, this domain must be introduced early, alongside other domains such as literacy (McClure et al., 2017). Together, these interconnected, mutually beneficial learning domains will produce knowledgeable citizens prepared for our continuously advancing future (McClure et al., 2017). However, Temple et al. (2022) demonstrated that there are substantial science achievement gaps in kindergarten by race/ethnicity. It has been suggested that early experiences with science integration in the classroom frequently affect future academic experiences in that field, highlighting the significance of meaningful experiences during those formative years (Archer et al., 2010). Developing foundational knowledge of the world begins at a young age yet the incorporation of STEM education is often stifled due to anxiety and low self-confidence experienced by both parents and teachers (McClure et al., 2017). Despite this, implementing STEM education into the curriculum should begin during these crucial years in order to promote a more diverse workforce, which can only be accomplished by identifying and eliminating existing barriers.

Importance of Preschool Years

Access to high-quality preschool education can help children transition to kindergarten easily (Desimone et al., 2004) These preschool settings foster a variety of developmental areas, including the social and emotional domains, which ultimately support academic success, self-esteem, and emotional growth (Landy, 2009). Prosocial behavior patterns are frequently seen in patterns of consoling, cooperating, assisting, and sharing that can be learned during these pivotal years, which lay the foundation for future growth (Landy, 2009).

The development of these qualities, which children can carry with them throughout their prospective academic efforts, has the potential to contribute to future academic achievement. Play and guided instruction are frequently used in the preschool setting to promote the advancement of these skills alongside language, cognition, and social competence, while also providing the opportunity for educators to observe skills and understanding (Copple & Bredekamp, 2009). In addition to the potential for supporting social and emotional development, a study by Aldemir & Kermani (2016) found that preschoolers can achieve higher levels of understanding in multiple domains when they are specifically supported through well-planned, stimulating, and developmentally appropriate activities. This highlights the need to focus on these early years of learning.

The Impact of Head Start Programs

According to reports, students from low-income families underperform academically compared to their peers from higher-income families when they first start school (Magnuson & Duncan, 2006). Despite the fact that a great amount of attention has been focused on the racial inequities that exist in school readiness, it has been found that the disparities between lower- and higher-income children may be almost twice as great (Reardon & Portilla, 2016). This is crucial to consider because financial stability is frequently a reliable indicator of the quality of the resources that are available, which affects the accessibility of stimulating learning opportunities and environments. In turn, access to resources is commonly associated with future access to possibilities like high-quality schools and higher education (Bradley & Corwyn, 2002) In order to combat this gap, it is essential to begin early with proper resources. It has been found that access to preschool education exists as an essential tool for low-income students (Dodge et al., 2016). Access to this tool has the potential to improve short and long-term outcomes as well as address income-related achievement gaps (Dodge et al., 2016).

With the overall objective of enhancing school readiness among low-income children and thereby closing the achievement gap, Head Start programs were created with the idea of supporting children's development using a "whole child" approach (Zigler & Styfco, 2010). The advantages of Head Start education and experience are not limited to early years, it carries on to adulthood (Bierman et al., 2008). This is achieved as Head Start promotes not only academic performance but social and emotional development as well, influencing future academic experiences. Therefore, Head Start has the potential to increase opportunities and help close the achievement gap that exists today (Bierman et al., 2008).

The Importance of Science and Inquiry in the Classroom

Early learners come to school with curiosity that is fueled by their own personal experiences with the natural world (Paños et al, 2022). With the right tools and guidance, they may then translate these personal experiences into new concepts and ideas. Depending on their age and developmental stage, children may formulate and respond to questions about scientific subjects at different levels, underscoring the need for appropriate strategies when approaching these subjects (Paños et al., 2022). Inquiry-based learning is one strategy that has been shown effective because, when applied in the correct circumstance, it can provide students with a sense of independence and control. Inquiry-based learning, such as Reggio Emilia’s educational approach, has demonstrated the potential to influence the development of complex abstract reasoning processes. Teachers who understand the tenets of Reggio Emilia are able to influence productive instructional time with the appropriate resources, space, peer interactions, and motivate the development of advanced inquiry processes (Westerberg & Vandermaas-Peeler, 2021).

Considering this, when given the opportunity to develop their own questions and learning, children are able to promote their learning and self-confidence in science and other areas (Andersson & Gullberg, 2012). Similarly, students should have the opportunity to participate mentally and physically in scientific practices, giving them a chance to submerge themselves within the activity and practice useful skills such as predicting, classifying, and drawing conclusions. These activities strengthen understanding and inquisitive skills that can carry into other domains of learning (Kallery & Psillos, 2002). Therefore, by encouraging the integration of science within the classroom, students are provided with the opportunity to develop skills that not only help them in science but also contribute to academic success in other domains throughout school. This further supports the need for prepared educators, especially within this subject, allowing preschool programs to assess and reinvent their approach to science education.

The Impact of Teachers

Teachers can direct productive scientific learning activities in a variety of ways, including the use of suitable questioning strategies (Hamel et al., 2020). As a way to direct science activities, teachers can provide students with developmental projects, explanations, and direct questions (Kostelnik et al. 2015). Hamel et al. (2020) found that when asking questions in the classroom, open-ended questions allow for deeper thinking, and when addressing scientific topics, teachers were more likely to ask open-ended questions. Overall, these findings suggest that teachers are able to use science activities as opportunities to encourage exploratory thinking, which contributes to a productive learning approach.

In addition, Bustamente et al. (2018) discovered a link between assisted learning approaches developed and supported by teachers and science preparedness. Learning approaches are ultimately applicable to any subject and refer to a set of abilities that enable students to discover and apply knowledge, as well as how people approach learning obstacles. In essence, this implies that if students are encouraged to establish persistence, flexibility, and open-mindedness within their learning approach, they will be better prepared to excel in science, as well as other subjects (Bustamante et al., 2018). By supporting the development of a learning style in addition to a set curriculum, teachers are able to encourage a well-rounded learning experience.

In addition to recognizing the benefits of encouraging a well-rounded learning approach in young children, Bustamante et al. (2017) examined the unique relationship between learning approaches and improvements in science education. According to Ardura & Galán (2019), there are two overall learning approaches: deep and surface, which have the potential to support meaningful learning experiences. When teachers encourage the development of deep learning approaches, students are more likely to maximize meaning based on intrinsic interests and establish the applicability of the subjects. In contrast, kids who use surface-level techniques could restrict their learning objectives to just memorization out of a possible fear of failing and a desire to measure up to their parents' or teachers' expectations (Kember et al., 2004). Bustamante et al. (2017) hoped to examine the significance of the association between these potential approaches to learning and academic success. In order to measure the variables of approaches to learning and academic success within the science curriculum, two types of assessments were used as well as a self-report method for teachers.

One of the included assessments was *The Learning Express* assessment, which was designed for low-income, at-risk children and measured progress in vocabulary, math, listening comprehension, and knowledge of the alphabet (Bustamante et al., 2017). The second assessment was *Lens on Science* which specifically focused on student progress within the science curriculum including practice skills, content from life science, as well as physical and energy sciences. In addition to these student assessments, teachers were asked to complete a Learning-to-Learn Scale method which allowed teachers to self-report experiences of the learning behaviors of their students. Through these measures, the study was able to assess the current nature of students' learning approaches in association with their academic standing. After analyzing the results, the notion that there is a substantial association between approaches to learning and advances in scientific knowledge was confirmed, and it was also a predictor of long-term academic success.

While teachers have the ability to guide students in developing these beneficial learning styles, teachers are much more successful in doing so when they value the experience or subject of focus. Teachers are often driven by their own personal values and expectations at school, and in turn, their personal values frequently shape the development of their self-efficacy in the classroom. Ouwehand et al. (2022) suggested that when teachers value a subject and feel that it contributes to society or a student's future, this positively affects their overall quality of teaching, ultimately having a positive contribution of students' academic performance.

Barriers to Science Education

There is a strong link between teachers' preparedness and their children's achievement; yet, there are existing barriers, particularly for Head Start educators, that can obstruct engagement in several domains throughout the classroom. This can be caused by a variety of factors, including a lack of materials, perceived support, time, and qualifications, all of which can contribute to a lack of confidence and self-efficacy. A survey within a study by Hollingsworth & Vandermaas-Peeler (2016) distributed among fifty-one teachers inquiring about their current understanding of methods when teaching science revealed a consensus surrounding a lack of science-supporting resources. Following their report of needed materials, the participating teachers expressed the need for certain resources which would assist in the integration of natural processes in their science lessons such as types of books, maintained outdoor resources, and electronic devices throughout the classroom (Hollingsworth & Vandermaas-Peeler, 2016). A lack of resources within the classroom has the potential to result in the hindrance of optimal potential for the exploration of natural behaviors and processes throughout the classroom. Westerberg & Vandermaas-Peeler (2021) highlight how appropriate materials allow for children to make independent discoveries, engage in exploratory behaviors, manipulate and observe processes, and create their own opportunities throughout these processes.

Under circumstances of limited resources, educators are often faced with a lack of confidence, which may be one of the most significant obstacles to incorporating science into the classroom, as it can stifle effective teaching habits (Roehrig et al., 2011). However, a lack of resources is not the only source of low confidence among early childhood educators. In early education settings, science is one domain that is frequently avoided. This is attributed to a variety of factors, including science anxiety, a lack of confidence in one's ability to teach science, a lack of prior experience engaging in science-related activities as a student, or the belief that literacy and language development should be prioritized (Roehrig et al., 2011). These findings present the need for re-evaluation and potential intervention opportunities which would provide support for educators within this particular domain. While Greenfield et al. (2009) acknowledged the importance of self-efficacy, they also highlighted how a lack of time throughout the school day can exist as a barrier to teaching science. Despite the instance that educators may be equipped to teach these domains, due to the short length of the school day and the short attention span of young students, teachers frequently find themselves emphasizing the other seven readiness domains that are expected of them (Greenfield et al. 2009). In essence, the two main challenges that educators face when it comes to science education are a lack of self-efficacy and time management, both of which reduce the frequency of student engagement with scientific material in the classroom (Greenfield et al. 2009).

The Impact of Qualifications and Professional Development

Customized learning settings run by knowledgeable educators can best facilitate the incorporation of science education in the early years Piasta et al. (2015) acknowledged that exposure to science and math for young children prior to their entry in primary school is important, and those learning opportunities have a direct association with growth in academic outcomes. Within this study, teachers were asked to complete pre-experiment surveys and then attend professional development sessions specific to the science curriculum. After a month, teachers were asked to integrate the content of their professional learning sessions into their classroom and complete a variety of self-report methods, while the children completed pre-tests and post-tests to measure their progress throughout the study. After evaluation of these processes, the findings suggested that opportunities for integrating science into the curriculum increased with teachers' greater involvement in professional development (Piasta et al., 2015). Professional development opportunities provided teachers with the tools to increase productive instructional time, which directly influenced student outcomes. Preschool-aged students were able to exercise and take control of the classroom material.

While it has been found that teacher preparedness can lead to an increase in learning opportunities, Oppermann et al. (2019) discussed how professional development can directly support improvement within teaching methods. They highlighted why introducing science in the preschool setting is crucial and how it can be hindered based on teacher self-efficacy. Preschool teachers were more likely to offer science learning opportunities when they perceived themselves to be sufficiently qualified and well-supported. Oppermann et al. (2019) measured teacher qualifications, self-efficacy beliefs, and science-related practices and discovered that taking science-related professional development courses positively correlated with teachers' perceptions of their own scientific self-efficacy and the frequency with which they engaged in science-related activities within their respective classroom (Oppermann et al., 2019).Thus, professional development had a positive impact on both; teacher self-efficacy and science-related practices.

In essence, the preschool setting supports growth in a variety of developmental areas including social and emotional domains, ultimately producing readiness in early childhood years. Head Start was created with the objective of ultimately reducing poverty and educational gaps in low-income areas. While Head Start prioritizes its goal of fostering academic preparation in early children from low-income households, it appears that not all areas are tackled to the same degree, according to recent literature. When one considers that science is the lowest-performing subject among low-income families, this is not unexpected. This domain is important to examine because of its versatility, which allows students to develop skills that they may apply to other topics and throughout school. Despite the observed importance of science in the early childhood classroom setting, this subject is often met with hesitation from educators leading to a gap in academic curriculum. According to educators, the two fundamental challenges to integrating science content in the classroom are a lack of self-efficacy and time management. These limitations limit teachers' ability to use a hands-on approach when teaching science, as well as the amount of time students have with the material, prompting the need for intervention. Research suggests that professional development opportunities for educators have been associated with increases in the frequency with which science learning opportunities are introduced in the classroom. This potential increase in science introduction can be explained by an improvement in self-efficacy and confidence, which provides children with more opportunities to practice and build new skill sets specific to the science curriculum. Thus, the overarching purpose of this study was to examine North Carolina Head Start teachers' collective experiences with integrating preschool science instruction into the classroom using qualitative interviews. This approach was supported by the constructs of phenomenology, which is highlighted in the next section.

CHAPTER 4: METHODS

This study employed a phenomenological qualitative method designed to evaluate how NC Head Start teachers use and integrate science in preschool classrooms. The theoretical underpinnings of phenomenology guided the selection of the qualitative method of one-on-one interviews. The study of people's personal experiences in relation to a particular phenomenon was supported by phenomenology (Creswell, Hanson, Clark Plano, & Morales, 2007). The phenomenological concepts enabled qualitative research's efforts to explore and comprehend distinct experiences using specialized techniques (Creswell et al., 2007). For example, a phenomenological method was discovered to be useful in a study that attempted to explore the social reality of incorporating storytelling when teaching science. Anilan (2018) demonstrated the effectiveness of this approach by using surveys and documents to capture attitudes and experiences with storytelling in relation to the integration of science. For this study, a similar approach was considered appropriate, because by analyzing the lived experiences of teachers understanding their beliefs, instructional strategies utilized and everyday interactions, we hoped to gain insight into the phenomenon of science integration in a Head Start preschool classroom

The Larger NIH SEPA Study

This study is part of a larger state-level needs assessment study focused on specific needs, assets, and resources. This is being done with the intention of informing the development of teacher professional development resources for the Preschool Education in Applied Science (PEAS) Institute for Early Childhood Teachers. PEAS is a five-year grant funded by the National Institutes of Health (NIH) National Institute of General Medical Sciences (NIGMS) Science Education Partnership Award (SEPA). The overall objective of PEAS is to develop a teacher-professional development intervention that aims to improve children's science knowledge, the development of scientific language, and dietary quality while also increasing teachers' efficacy in teaching science and their instructional knowledge and skills. The needs assessment study is utilized to understand program needs, inform program and behavioral theories that will direct curriculum development, and identify the infrastructure and resources that are already in place within the Head Start settings across the state. Doing so has the potential to also identify key stakeholders, and gain momentum for intervention, evaluation, and sustainability. Thus, the current study was a subset of the assessment to complement the larger needs assessment data. This study was concerned with the integration of science in the preschool classroom. Prior to the creation of this study, the data of choice was already collected with the intention of observing the implementation of food-based learning within Head Start preschool classrooms (Dixon, 2023).

Participants and Recruitment

Eligible participants for this study were current employees of a Head Start-funded NC organization. All participants were at least 18 years old and employed as teachers (Lead or Assistant). Participants were recruited throughout the state of North Carolina after a comprehensive list of 54 Head Start-funded organizations was compiled. All organizations were then contacted by the research team. Before speaking with Head Start teachers, each Head Start grantee's education manager was contacted by phone or email to obtain their consent. They were then asked to share information about the study with their organization while maintaining anonymity among future participants.

Participants were contacted through email to participate in a brief survey which required them to provide IRB electronic consent prior to completion. Teachers were asked whether they were interested in scheduling a one-on-one interview with the research team to further explore their experiences with science in the classroom after the completion of the survey. Only teachers who indicated an interest in participation were interviewed. Before starting the interview, researchers verified that the survey was completed, and that consent was received. To recruit participants, this study utilized the snowball technique, which targeted a group of people who had similar attributes and operated with the use of referrals. For optimal participation from the target audience, participating teachers were requested to suggest and/or provide information for additional study participants.

Data Collector Training

The chosen training method used was the Goodell method (Goodell, Stage, & Cooke, 2016). Each coder and interviewer were required to participate in this 5-phase training method, ensuring that each individual is provided with consistent training, and exposure to the core principles of qualitative research, with a chance to exercise skills. The first phase required each participant to become familiar with the fundamental ethical principles guiding the use of human subjects in research, as determined by the provisions of Human Subjects in the Code of Federal Regulations (Goodell, Stage, & Cooke, 2016). The second stage of training involved introducing trainees to fundamental qualitative research techniques so they may get familiar with the procedures and responsibilities of each role. The third step of this five-stage training program provided the trainee the opportunity to practice what they have learned by participating in a simulated interview. During this stage, the student had the opportunity to practice taking notes and summarizing information while listening to a previously recorded interview.

Following the chance to practice summarization skills, phases four and five provided the trainee with the chance to conduct mock interviews, during which the trainee could practice conducting interviews while properly utilizing the interview guide. During phase four, the participant would be someone from the research team who is familiar with the protocol, as well as the training, while phase five included someone from the prospective participant population to participate in the interview. The fourth and fifth stages gave the research team the chance to evaluate the trainee's progress and offer feedback on any potentially harmful behaviors that might emerge during the research process, such as providing feedback that is more than is necessary, leading questions, counseling, or offering one's own viewpoint (Goodell, Stage, & Cooke, 2016).

Procedure for Data Collection

Interviews

Due to their individualized nature and the intent of this study to gather personal experiences, interviews were chosen as the method of data collection. The proposed interview guide was developed with the aim of encouraging general yet high-quality questions that would inspire meaningful conversations about the research setting, participants, and their experiences, as well as guide, but not dictate the interview (Oerther, 2021). Three registered dietitians from the field of nutrition science, three graduate students in the field of nutrition science, and three faculty members from the field of nutrition science worked together to design the study questions that were compiled to create an outline for the interview guide. Following extensive research to formulate the chosen questions, the interview guide was then reviewed and screened by the NIH team. Multiple changes to the manual were made, guided by group discussions, to avoid leading inquiries and maintain the manual's subject-matter emphasis. Prior to data collection, the interview guide was tested on at least three preschool teachers.

Interview Guide and Consent Process

The interview guide was made up of key inquiries that were meant to encourage in-depth conversation in addition to targeted inquiries that are meant to further shed light on participant responses. The interviewing guide inquired about how teachers are now integrating science education into the classroom and their experiences doing so. In order to reveal teachers' opinions and intentions on teaching science to young children as well as their perceptions of necessary reforms, the interview guide's questions gradually became more focused on these topics. *Interview questions directly related to science and teachers' experiences in integrating science into their curricula, as the proposed study is a subset of a wider study.* All interviews were conducted over the phone. Supported by the phenomenology approach, interviews were lengthy and in-depth, each ranging from an hour to an hour and a half. Participants were encouraged to find a secluded and quiet space to remain throughout the interview, while interviews were captured on a university-owned electronic device with the Rev App call recorder (e.g., iPad). Additionally, Rev was used to accurately transcribe audio files for data analysis. To ensure the accuracy of these transcription methods, research team members were appointed to conduct random spot checks throughout the interview recordings.

Ensuring consent was a continuous component throughout the study as researchers confirmed completion of the survey along with consent prior to the interview. Researchers also informed participants that their relationship with their worksite, East Carolina University, NC State University, University of NC Greensboro, or NC A&T State University will not be negatively affected by their decision whether or not to participate in this research study. Confidentiality was always ensured. Participants were also made aware of their ability to remove themselves from the study at any point in time. As a form of compensation, $30 gift cards were provided to teachers partaking in individual interviews and completing the associated survey.

Procedure for Data Analysis

The data analysis process included transcription, coding, and an overall summary of the common themes. The qualitative interviewing technique employed a phenomenological approach to examine and document the common life experiences of participants (Creswell et al., 2007). This approach was chosen for this study because it was crucial to understand the experiences of individuals in order to better inform policies and practices in relation to the phenomenon (Creswell et al., 2007). When the researcher was given an opportunity to analyze the transcribed interview, each transcript was read a few times and memos were added throughout the transcripts. Memos are informal notes, challenging the researcher to highlight and document whatever comes to mind (Rogers, 2018). These memos represented the ideas and themes of the lead researcher that have been recognized during this exercise and were documented throughout the transcripts (Charmaz, 2015; Rogers, 2018). While a codebook for this data was created for the previously conducted study, the lead researcher and the team member familiarized themselves with the codebook again. After reading through the already established codes, the lead researcher read through the transcripts again in order to categorize each memo using a descriptive code that represented the memo (Rogers, 2018). Help and guidance from the other team member was solicited as a second coder. After assigning codes throughout the transcripts, the researcher read through the transcripts once more, focusing on the codes with the intention of recognizing patterns and commonalities throughout the transcripts. The researchers then produced a descriptive narrative that captured the participants' common experiences with the inclusion of science in the classroom. Thus, the researcher followed the four steps of in-depth analysis: coding, identification of themes, categories, and narrative.

Approach and Trustworthiness

The goal of this study and its corresponding qualitative methodology was inspired by phenomenological concepts, which supports authentic reflection of the unfiltered experiences of the participating teachers and highlights meaningful patterns found within their responses. To ensure credibility, the researcher/s closely reviewed existing literature to identify relevant methods, procedures, and findings for this study. Following this, researchers participated in debriefing sessions to establish a consensus of theories and interpretations relevant to the study, which was subject to feedback.

Throughout this study, rigor and reliability-focused strategies were employed. Bracketing a deliberate action of the researcher to recognize potential biases and suspend any expectations or views about the phenomenon of focus was employed (Padgett, 2017). Qualitative memos utilized during coding was used to challenge any thoughts, ideas, or look for potential biases with the other coding partner. Additionally, team members met every week to discuss during the data analysis phase. Returning to the data and having discussions until a consensus was reached was an important part of the coding and theming process (Padgett, 2017).

CHAPTER 5: RESULTS

The final sample consisted of 35 teachers from 16 counties in NC's mountain, piedmont, and coastal plain regions. Although saturation seemed to have been achieved at interview number 31, four more interviews were conducted to confirm it. At the time of the interview, the participants were 94% female and had an average age of 40.8 ± 10.06 years. The two most common racial groups among teachers were White (53%) and Black/African American (44%). The majority (97%) of teachers were non-Hispanic, while the minority (3%), were Hispanic. Many teachers held either bachelor's (54%) or associate's (20%) degrees. In addition to Head Start, the majority of teachers (83%) had experience working in preschool settings.

Theoretical Model

The EVT proposed and employed by Abrami et al. (2004) to understand instructors' beliefs in connection to expectations, value, and costs when it comes to instruction formed the backbone of this study. Thus, using the structure provided by the EVT theory and the findings of the study, a visual model was created to represent the data findings. In the model, we highlight the various themes identified from the perspectives of the Head Start teachers (see Figure 1). This theory is driven by the idea that an individual's decision-making process involves an analysis of the costs and benefits considering three primary factors: values, costs, and expectancies (Day, 2020). After evaluating the themes that emerged from the interview responses and studying the structures of expectancy-value theory, it was clear that each of the themes fit well within the proposed structure of the theory. Teachers expressed their values—described as personal experiences and preconceived notions of science, perceived costs of incorporating science—described as challenges and barriers, and expectations that guided their efforts. Thus, the identified 5 themes and 12 subthemes were incorporated within the stated model below. In the next section, we describe this model in greater detail.

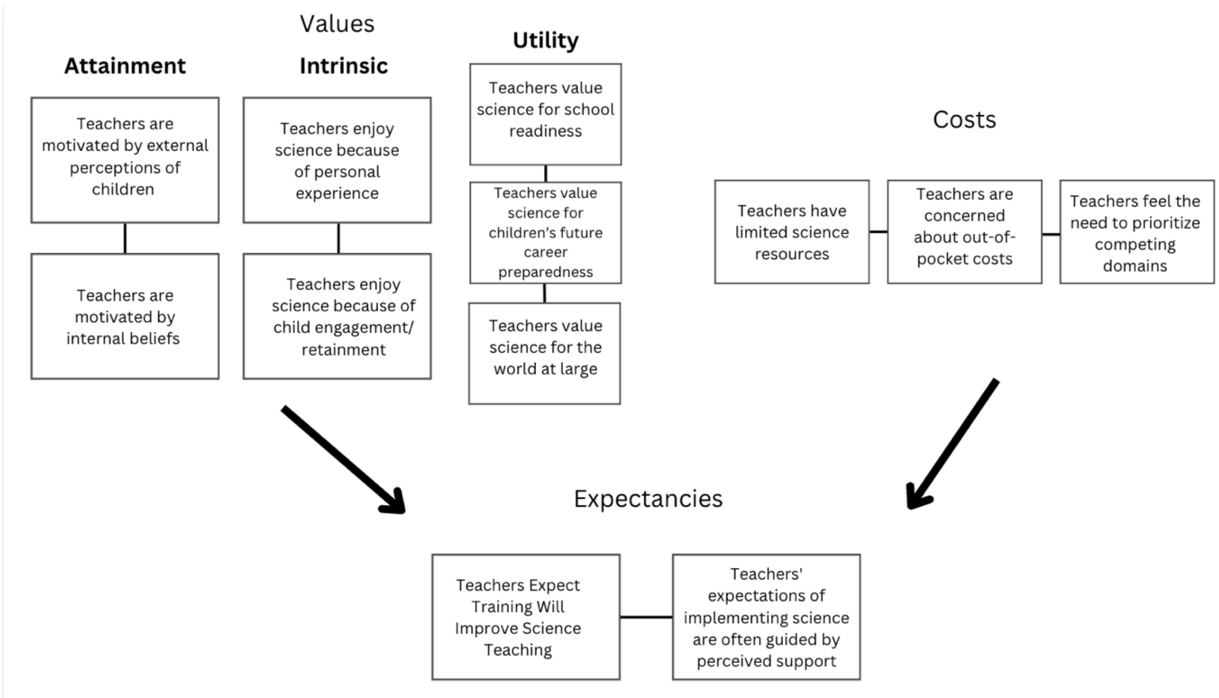

Figure 1. Model of Head Start Teachers' Experiences with Preschool Science Education

Values Described

Theme 1: Attainment value

The attainment value conveys teachers' *perceived level of importance* for science in the classroom. Teachers' attainment values were driven by various factors, including their perceptions of the children they serve and their innate motivation for creating science learning experiences in the classroom.

Subtheme 1: Teachers are motivated by external perceptions of children

For this study, many teachers reported that they hold a personal value of science as a learning domain in the classroom. Many teachers expressed that they find science to be crucial for exploration as well as a fundamental aspect in all domains (NZ_11; NZ_07). When implementing science, students are able to learn about the processes that they are already commonly exposed to, especially those in their own homes. For example, one teacher stated, “we dealt with a lot of different things that they could use at home” (NZ_07) so they are able to make the connection between home and school. Teachers valued implementing science in the classroom because many children may not have access to this information at home. One teacher expressed that they feel that the population they serve may not be able to do a lot of experiments or have access to much dealing with science, emphasizing their motivation for allowing children the chance to go outside and engage directly with their environment. One teacher felt that the more exposure children have to science, the more they might find that they have a love for the subject.

Subtheme 2: Teachers are motivated by internal beliefs

Another motivating factor for teachers included their personal beliefs about science as well as its perceived value to the classroom, which has the potential to directly affect the quality of the implemented curriculum. Teachers reported an internal belief that implementing science is important. This belief motivated teachers to seek out new ideas and activities for science. For example, some teachers mentioned that they have access to science activities provided by programs such as “Growing Up Wild” which offers some training as well as a guide for activities, or “Steve Spangler” which provides science kits and guides. However, they would often use platforms like Pinterest to locate additional science activities in their classrooms. One teacher mentioned Pinterest as a valuable resource as it offers “multiple DIY products or suggestions that will allow you to make certain adaptations for children who you may have to make certain adjustments for…" (NZ_05). Because of their value for creative science lessons, teachers reported seeking ideas from nontraditional resources.

Theme 2: Intrinsic Value

Teachers' expressed motivation to teach science because science is something that they personally enjoy reflecting teachers' intrinsic value for science. Several intrinsic values were highlighted by teachers, including beliefs that science is exciting from personal experiences and science is enjoyable because of children's engagement with the topic.

Subtheme 1: Teachers' personal experiences influence their perceptions of science

Teachers reported valuing science because of previous personal experiences. One teacher highlighted an experience with her father where they went on a nature walk and collected leaves all over western North Carolina (NZ_10). Another teacher expressed satisfaction with the manner they were exposed to science as a child, particularly the chance to explore and spend as much time outside as possible. This teacher felt that these previous experiences helped to guide their teaching methods, influencing them to provide exploratory and hands-on lessons. Conversely, other teachers stated that they find science boring. One teacher described science as their most difficult subject in school, while another described that they associate science with writing pages and pages of notes. Whether positive or negative, teachers indicated that their personal interactions with science had an impact on the value they place on the subject.

Subtheme 2: Teachers enjoy science because of child engagement/retainment

Teachers also personally enjoyed science when they received engagement from children when implementing science in their classrooms. Some teachers reported that they implement science and related activities in their classrooms because it gets them excited. One teacher commented that they felt more motivated to initiate science activities if it was going to be fun and interesting, while another teacher mentioned that they are driven by seeing how much their children enjoy the lessons. Teachers defined engagement as being excited, paying attention, and asking questions. One educator stated that “if they're wanting to learn more, and they're engaged and seeking more information than that tells me that I'm on the right path.” (NZ_10) Teachers all reported that they enjoyed science lessons when children retained the information stating it made them feel successful. One teacher stated “When you go to group time later or small group activity or the next day when you're asking questions… [the children] they're able to reflect on what was done before. That means they're retaining some of that information from the experience that you created for them.” (NZ_05)

Additionally, teachers also reported utilizing family engagement as a gauge of children’s achievement in science as they welcomed hearing from the family how the child was able to utilize the knowledge at home. Knowing that the children enjoyed the science lessons and demonstrated retention served as motivation to continue incorporating that particular lesson. Additionally, when incorporating engaging lessons, teachers were often driven by this concept of creating a “wow factor” with many science experiments because they wanted to see the reaction and interest of students. Teachers mentioned some activities such as volcanoes, making slime, and growing activities because they found that they enjoyed implementing these experiments due to the reactions from the children. Unfortunately, this motivation for “wow factors” often motivated teachers to utilize “one-and-done” experiments, that lacked a connection to concrete learning objectives and the process of science.

Theme 3: Utility Value

Teachers detailed descriptions of the purpose and usefulness of science, both inside and outside the classroom, revealed overarching patterns that define teachers’ perceptions of and the utility of science. Teachers emphasized that science provides general knowledge, helps children connect to the outside world, and strengthens skills that are not only applicable to the classroom but their future academic endeavors and potential career interests.

Subtheme 1: Teachers value science for school readiness

Many teachers emphasized the importance of a thematic/hands-on approach to science teaching, showing applicability to children, in order to promote the development of versatile skills. Many teachers reported that they enjoyed incorporating hands-on activities because the children were excited to be able to do it themselves and have their own experience with science. For example, one teacher emphasized that “because preschool, they're hands-on, that's how they understand, they touch stuff and feel stuff. They want to experience it. I think we learn more when we're experiencing it ourselves.” (NZ_01). One teacher touched on this when they mentioned that they would base their activities on the season and the topic so children could directly relate the lessons to their immediate environment. Another teacher mentioned that they value a thematic approach to science because it allows the children to experience things through touch and take control of the activity. Through this method, there is an expectation of higher retention and a greater understanding of concepts, contributing to school readiness.

Subtheme 2: Teachers value science for future career preparedness

Teachers also mentioned that they find science valuable because it motivates the development of various skills that are applicable in various domains. When asked about what motivates them to teach science, teachers stated “science is what our world is coming to” and “science really builds the critical thinking skills, which are important in any field of work that they go into,” (NZ-09). One teacher stressed the importance of motivating a child to investigate their surroundings and how this directly influences how they view science as they age.

Furthermore, allowing children the freedom to discover and comprehend their surroundings gives them the possibility to build a sense of safety that they might not otherwise have. According to another teacher, cultivating an early understanding may alter future learning interests. This could have an impact on future interest in STEM education in public schools. Teachers value science as it supports the development of applicable skills which will not only prepare children for school but their future careers as well.

Subtheme 3: Teachers value science for the world at large

Teachers expressed the utility value of science by stating that science serves as a foundation for success for children through school and in other aspects of life. Educators expressed that science supports the growth of general knowledge for children. One teacher explains,

> It's important for them to ask questions about why things work the way they work, and to pay attention to what's going on in the world around them because science is all around us, and things are changing all the time. I just think it's good for them to be able to stop and reflect and to ask questions so that they can learn as they get older to ask why does this work in that way, and to be able to interact and talk with other children about things that's going on around them. I want them to learn and to ask questions. (NZ01)

Other teachers echoed this sentiment and felt that science is important because it can be identified in all aspects of life. One teacher expressed that "science really ties into every domain of development" (ZP_08). Teachers reported integrating science in math, literacy, and cooking lessons. For example, one teacher reported that they incorporate it "along with learning language arts. Writing group, writing tally marks, graphs, charts, predictions" (NZ_12) demonstrating how science can be found in many domains throughout the classroom.

Furthermore, teachers discussed how science is interconnected with all human experiences. One teacher emphasized the importance of fostering children's innate curiosity in their surroundings, providing children with the tools to develop an understanding of their personal experiences. When fostering innate curiosity, children are instilled with a sense of control over their learning. One teacher noted that when you do that, you are teaching the child that they matter while giving their voice and opinions meaning. Additionally, a few teachers highlighted that they value science because "science is a part of everything we do." Considering this, one teacher mentioned that it is important to discuss how science is related to our everyday life and processes. Teachers mentioned that this could be found in explaining everyday tasks or common processes such as cooking, going outside, washing our hands, or observing the changes of the seasons.

Perceived Costs

Theme 4: Barriers to Science Education; Costs

Most teachers commented that they saw no reason why science shouldn't be taught in the Head Start environment. However, teachers faced costs in the form of barriers to incorporating science within the preschool classroom.

Subtheme 1: Teachers have limited science resources

One of the largest barriers teachers faced when trying to teach science in their classrooms was limited resources. Teachers mentioned having science materials such as microscopes, magnifying glasses, kaleidoscopes, blocks, measuring tape, and balance scales (NZ_04; NZ_18) but mentioned that they could benefit from additional resources such as weights, magnets, and other supplies to conduct simple experiments. When met with a lack of resources, one teacher expressed that it was difficult to be creative and lessons may begin to be repetitive without additional tools in the classroom. For example, one teacher expressed that if they did not have what they felt they needed, they may have to alter their lesson entirely because they are not able to adequately carry out the activity. One teacher reported wanting to make strawberry smoothies with the children after they had grown their own strawberries, but the teacher stated, "we were struggling to get the materials or buy the materials, and so we just had to completely X the smoothies and they just ate the strawberries" (NZ_13) Additionally, teachers expressed the need for materials due to their ability to provide unique learning experiences for each child. Another teacher reported the need for more materials because each child learns differently and that

Every child learns differently. By providing more materials per each child and more hands-on learning experiences, that's going to provide more than one way of learning for each child. Some children learn hands-on, some children learn visual. I think that those experiences and having their own materials are going to provide and reach each child a little bit better than just look at this picture. (NZ_15)

Subtheme 2: Teachers are concerned about out-of-pocket costs

Many teachers expressed that when they wanted to incorporate science lessons, they were met with a lack of materials and often paid for the materials out-of-pocket. One teacher elaborated by expressing that they "spend quite a bit of money, but just because you want them to have that enriching experience" (NZ_16). Additionally, teachers' decision to purchase materials out-of-pocket may be connected to a lack of administrative support. In one case, a teacher commented that the perceived level of support is dependent on the level of communication within the school and the response of administrators is often inconsistent and can take more than a year. Having a lack of administrative support makes it difficult to ask for assistance and it was emphasized that this affects the availability of classroom resources.

Subtheme 3: Teachers feel the need to prioritize competing domains

Teachers expressed that they find it difficult to incorporate science due to the motivation to prioritize competing domains, such as math and literacy. One teacher expressed that they are often not encouraged to focus on science and as a result, it gets pushed to the side when they are encouraged to focus on literacy and math. Another teacher stated that when incorporated, science lessons are "just kind of thrown in there sporadically versus really focusing on it." (NZ_09) This could be explained by a lack of available training. One teacher stated that they have not received training because it is not made to be a priority, and "if a teacher wasn't pre-determined to teach science, it could go a whole year or a whole month, a whole week of not talking about it" (NZ_12) Therefore, with a lack of training or motivation to incorporate science, teachers are less likely to feel comfortable doing so. These reports were consistent with those highlighted by Greenfield et al. (2009); It was found that teachers tended to concentrate more on the other seven readiness domains due to the short length of the school day and the limited attention span of young children.

Expectations for Incorporating Science

Theme 5: Expectancies

Teachers formed overarching expectations about the implementation of science. These expectancies affected the quality and frequency of science that teachers provided. Teachers' expectations were based on many factors derived from past and current circumstances, which were at times positive (values) and at times negative (costs).

Subtheme 1: Teachers expect science training to be critical

The majority of teachers mentioned having received or desiring to receive science training. Educators who had not experienced appropriate science training reported a lack of confidence when teaching science and so they consequently did not expect the science they taught in the classroom to go well. Teachers often recognized science lessons didn't go well by acknowledging that "my vision and what actually occurred were very far apart". For example, one teacher stated "if I didn't feel prepared, if I don't have everything laid out and ready to go, then that just starts it off all wrong because I'm struggling to stay caught up and … I just quit it. We put it aside and try it later." (ZP_01) Some teachers were so concerned about their low science efficacy that they expressed an expectancy of failure. For example, one teacher confessed hope that no one would come to observe the science lesson:

> if I was struggling, I would hope that nobody would come in and do an observation because I know I wasn't that prepared. Something that I might would have thought was a good idea. If I was doing a really good job, I'd be like, "Oh, I hope I get observed today." Sometimes, they did come in during those times. Then I could tell they were pleased with it if they told me I was doing a good job or whatever. (NZ_14)

In addition to teachers' expressed concerns about the lack of science training they had received, teachers felt unprepared to teach science and that some activities were not developmentally or age appropriate. One teacher expressed that some concepts may be too complex for preschoolers and difficult to teach without training. Other teachers emphasized that even if a concept was explained at a developmentally appropriate level, they expected challenges with the differing levels of abilities amongst the children in their classroom. These expectations manifested themselves in teachers' ultimate fear that if the science material was perceived as too complex by the children, teachers may actually "turn them (the children) off" to science entirely.

For example, one teacher stated that when incorporating something that may be too difficult, "even if you try and bring it down a few levels sometimes they don't get interested in it because they're like oh yeah we already did something like that and it's not something I want to do again" (JB_02) Teachers expressed disappointment in themselves that they have not been successful in teaching science concepts adequately. Teachers identified a desire to learn how to teach developmentally appropriate science to increase confidence in their lessons.

Conversely, teachers who reported having experienced prior science training felt more prepared to incorporate science. Teachers who had received training expressed more positive expectations and confidence that the lessons would go well, as a result of feeling more prepared. Teachers stated that educators flourish when they are confident, so prepared/trained educators would be more likely to incorporate science in their classrooms.

Subtheme 2: Teachers' expectations of implementing science are often guided by perceived support

Teachers also reported that their expectations are often determined by their perceived support. When teachers perceive themselves as having support, they are more likely to expect successful outcomes when incorporating science. Teachers reported being supported by colleagues and being able to "bounce ideas off of other teachers." One teacher expressed that they found it helpful to be able to turn to their colleague for advice when something did not go well, which contributed to an overall supportive environment for incorporating science in the Head Start center. Additionally, teachers reported that administrative support acted as a barometer for their expectations for science in the center. For example, teachers expressed that not only do administrators provide resources and feedback and encourage collaboration and new ideas, but they can also encourage activities that incorporate family involvement as well. In this way, administrators' involvement in science in the centers directly impacted teachers' expectations.

Additionally, teachers expressed expectations for science directly related to their access to resources, influencing how prepared a teacher felt to implement science. Teachers listed a plethora of external resources that contributed to their expectations for science success such as lending libraries, volunteers, and visitors. Lending libraries were highlighted by a couple of teachers as a partnership that provides access to books and toys, as well as offer trainings. Volunteers and visitors also offered assistance in the classroom and offer a unique and memorable experience for the children. Visitors have the ability to discuss outside processes which may be applicable to the science curriculum. For example, one teacher expressed that they live in a large apple-producing region and she invited some apple growers to come and discuss with children about their jobs and the science of growing food in their region. With this opportunity, children were able to make connections between their classroom lessons and their communities. Teachers stated that access to a variety of outside resources, such as these, increased their expectations of science success in their classroom.

While teachers expressed their hesitations when approaching science in their HS preschool classrooms, many expressed their values and beneficial resources. We hope to use these findings to contribute to the growth of support among teachers when it comes to introducing science in the preschool classroom. Significant quotes representing each theme are presented in Table 1.

Table 1. HS Teacher Quotations for Themes Aligned with the Expectancy Value Theory

Theme	Subtheme	Example Quotes
Attainment Value	Teachers are motivated by external perceptions of children	"That would be the most thing that I would do, mix colors or make slime because it's fascinating to them. It's something they've never done before. They like doing it. They might not have ever done it at

		home, so they come to a place of learning and that's what they like to do." ZP_14 "Mainly we serve underprivileged children, and a lot of children will not have access to different science activities, different science topics in their households. So, that would help a great deal" NZ_07
	Teachers are motivated by internal beliefs	"I think you just have to really be open to learn. Science is a very teachable thing, that you can learn yourself, doing research. You've just got to have the will and desire to actually want to do that. Some teachers don't care to elaborate too much on it, versus others. It could be that I'm kind of younger and understand child development, based on my major in undergrad. Before anything else, you have to have a will and desire to want to teach your kids more." ZP_08 "I try to set my standards high. I want to do a good job and I try to abide by what's going on... what the supervisor expects [DJ1] of me. So, I try to set my standards high. And I want to do a good job" ZP_03
Intrinsic Value	Teachers' personal experiences influence their perceptions of science	"Probably more than anything else it's just how I grew up, how I was exposed to things as a kid going through school. And we spend as much time outside as possible, so we don't just stay on the playground, we walk through the neighborhood. So things are constantly changing in the neighborhood, so they're not seeing the same thing day after day after day. " ZP_12 "The vocabulary, just knowing to use certain vocabulary words. Having that foundation, I think, is helpful. Just having had my own personal knowledge and applying that to my lessons. Using just general vocabulary, really, and then teaching them so that they understand what I'm talking about and really get the most out of your lesson." NZ_16
	Teachers enjoy science because of child engagement/retainment	"When you go to group time later or small group activity or the next day, when you're asking questions, the children are able to say, "We shook it up!" or they're able to reflect on what was done before. That means they're retaining some of that information from the experience that you created for them." NZ_05 "It's just very interesting, to get their intake on it, because kids are wildly smart than what we really think. It's just fun to have them be really engaged. It's something that they actually express interest in, in the first place.ZP_08
Utility Value	Teachers value science for school readiness	"Well, I think with preschool science and education it would go back to what those developmental milestones are for that age, so of course they're going to be working on their language and their going to be working on their fine motor skills, their going to be working on their gross motor skills and all those things can be incorporated. So when planning you just always try to think, how can I help this child develop in a developmentally appropriate way." NZ_02 "If you engage with them now, then when they get into school it's not new, it's not, "Oh gosh, I don't know what any of this is." They have a basic knowledge and some of the science words won't take them by surprise and some of the science activities they might do them again

		or something similar. They'll know how to work in groups and they'll know how to answer some of the questions. It'll just give them a good basic knowledge and it gets them ready for whenever they start elementary school.” ZP_01
	Teachers value science for future career preparedness	“Science is a lot of what our world is coming to, like the medical field and technology, all of that is based in science, [BJ1] and science really builds the critical thinking skills, which are important in any field of work that they go into,” NZ-09
	Teachers value science for the world at large	“I talked to them about how science is important in our everyday life. Whether its cooking or going outside, washing our hands. If we don't use warm water the germs in our hands won't go away. Or if they go out in the back and seeds hasn't changed and the grass isn't green is because this season has changed from spring to summer to fall to winter. And so it's like science is a part of them every single day…“ NZ_06 “I can't think of a reason why you wouldn't. I mean, I just think it's so exciting and it's fun, it's so important. It teaches so many things. It ties into so many aspects of their life and their world more so than they realize. I think you're doing them a disservice if you don't teach them science related topics.” NZ_16
Barriers to Science Education; Costs	Teachers have limited science resources	“The benefits of making those changes would be to reach each child. Every child learns differently. By providing more materials per each child and more hands-on learning experiences, that's going to provide more than one way of learning for each child. Some children learn hands-on, some children learn visual. I think that those experiences and having their own materials are going to provide and reach each child a little bit better than just look at this picture.” NZ_15
	Teachers are concerned about out-of-pocket costs	“A lot of times we buy our own materials. If we want to teach something, we just go buy whatever we decide to teach.” NZ_01 “Funding is up to the teachers. When you go to the store to purchase 16 pumpkins, it may not seem like a lot to a program, but it is a lot for an individual” NZ_15 “Or not having resources, that have to come out of pocket a lot for what you do in your classroom. I spend quite a bit of money, but just because you want them to have that enriching experience. So that's the biggest challenge” NZ_16
	Teachers feel the need to prioritize competing domains	“When it comes to science in the classroom, they want us to talk about science, but in my opinion, I feel like there is a bigger need ... I just think it's more focused on literacy and math, because even when we do ... Let's say the end of the quarter, we're [inaudible 00:38:56] the kids, with science, the only thing it says is, "Meeting expectations

		or not meeting expectations." When it comes to literacy and math, in one section, I might have 20 questions on each of those things. I'm not saying that my supervisor ... I just don't know that science feels as important for Headstart as some of the other things.” ZP_10 “But I think we get so focused on those, and so science gets kind of pushed to the side.” NZ_09 “I know they don't put as much emphasis on it (science) as reading and writing and math, so to speak, but I can't really think of any reason that you wouldn't.” JB_01 “I think the first thing that comes to mind is that it's not emphasized enough. I think we focus a lot on the cognitive skills, like literacy and mathematics and stuff, and science just comes from those. We focus on those, and as you know, in early childhood ed pretty much everything intermingles, all the domains, you can pull science, math, from anything that you teach, but I think we focus more on math and literacy and language than we do science. They're just kind of thrown in there sporadically versus really focusing on it.” NZ_09
Expectancies	Teachers expect science training to be critical	“I feel like the more the teacher knows about those areas, when children are asked questions, you can turn any experience into a science lesson. The less you know, it's hard to incorporate that into a science lesson. But definitely the more you know about different things and how to incorporate those. Just talking to you, I see now we actually incorporate the science in our classroom, even though I didn't realize it. The same with having some kind of training, we would be able to recognize that, "Oh, this is a great way to incorporate science into the lesson, because this is what they're talking about." NZ_17 “I think that would be fun just to have a little bit more hands on training and learning about science, and different ways we can teach science.” -NZ_04 “I think what does a preschool child need to learn science? I know every grade has this and this and this for what they need to be learning in science, but at preschool age, I don't know what that is. I would love to have a training about that, for preschool age.” NZ_17
	Teachers' expectations of implementing science are often guided by perceived support	“I think it probably helps, the encouragement from your superiors to come up with an activity that the whole family can be involved in, or you can be involved in the classroom. That just kind of encourages you to be searching out different things that you can do.” NZ_01 “Teaching science, what's the most supportive, I would say accessibility of resources. I feel that I can provide for the children anything I need to...There's never a time when I want to teach something that don't have the resources to do it. ” NZ_12

CHAPTER 6: DISCUSSION

The use and integration of science by Head Start teachers in the preschool setting were investigated in this phenomenological study. The frequency of science integration in the classroom was determined by a complex system of events, patterns, underlying structures, and preconceived notions, as indicated by evaluation of teachers' responses. The results of this study provided detailed insight into the experiences and perspectives of science education as reported by teachers themselves and were arranged into 5 major themes in accordance with the Expectancy Value Theory's suggested organizational scheme. This theory is driven by the idea that an individual's decision-making process involves an analysis of the costs and benefits considering three primary factors: values, costs, and expectancies (Day, 2020). Therefore, teachers' perceptions of the values, costs, and expectancies associated with incorporating science within the preschool classroom determined the frequency with which they actively implemented science.

Teachers value science for a number of reasons including its ability to contribute to school readiness, future career preparedness, as well as an understanding of the world at large. When teachers have a preconceived value for science, it was reported that they are more inclined to teach the subject. Teachers are motivated by their desire to help students, and many stated that science was valuable to them because of how they perceived their students and how accessible science was to them outside the classroom. According to expectancy-value theory, this value is referred to as attainment value. Teachers were encouraged to integrate science in their classrooms despite their perception that students might not have these kinds of interactions within their homes. Many of the teachers prioritized sharing knowledge that they believed students might not otherwise have access to.

Additionally, intrinsic value was a great motivator as a teacher's prior knowledge of the subject serves as a powerful drive for teaching that subject. Teachers were more willing to teach science if they had previously had positive experiences with it because they were eager to pass that on to their students. Similarly, they were more willing to conduct a lesson if they believed it would increase student engagement. As a result, students were more likely to pay attention to a topic if teachers were ready to present an engaging lesson.

Teachers were inspired to teach science if they believed that it would help the students succeed in the future, whether that success was academic or related to future career success, which is referred to as utility value. According to Gallery & Psillos (2002), teachers recognized the adaptability of the scientific curriculum because the corresponding abilities are also applicable to other preparation domains, making it a widely beneficial domain.

While teachers reported implementing science within their preschool classrooms, they were confronted with several challenges. Specifically, when teachers were implementing science, this was often done so sporadically and not as a main domain of focus. This was due to a variety of factors such as a lack of preparedness, limited resources, perceived lack of support, and the motivation to focus on other learning domains. Considering these circumstances, improved and expanded professional development opportunities have the potential to help teachers broaden and extend their skills as well as redefine their perspective and expectations of science education (Duran et al., 2009). In order to successfully improve teaching practices, professional development opportunities strive to motivate change in teachers' beliefs, confidence, and knowledge (Clarke & Hollingsworth, 2002). Doing so has a direct association with the frequency of incorporating science and in turn has been found to be positively related to children's learning gains in science (Piasta et al., 2015).

Science is often not the main focus of the classroom due to competing domains such as math and literacy which are perceived to be more important during this stage (Roehrig et al., 2011). In this study, teachers mentioned being less motivated to incorporate science lessons because they felt that there was less emphasis placed on this domain. There also is a lack of training focused on incorporating science as compared to training in other domains such as literacy, math, and cognitive processes. Additionally, teachers also faced a lack of appropriate resources and science-related materials. Teachers were less likely to implement science activities if they did not feel that they had the proper resources. Facing a lack of proper materials in the classroom can hinder a teacher's ability to foster an environment of exploration (Westerberg & Vandermaas-Peeler, 2021). When seeking resources, teachers faced inconsistency from administrators which then influenced their ability to implement activities that they previously planned or felt were most appropriate for the topic. This often resulted in the need for teachers to pay for needed materials out of pocket because teaching science was important to them. There is a need for greater accessibility to resources and materials so that teachers have more discretion to implement more creative and engaging science activities. However, to combat this lack of materials as well as promote the importance of science curriculum, the perspective of science as a necessary domain must be re-evaluated and adjusted on many levels. Expanding awareness of the crucial nature of early science incorporation among administrators and policymakers would support the demand for increased resources.

Seemingly, teachers were not encouraged to prioritize science, however, when it was incorporated as a main lesson, in most instances this was done in a more extravagant manner (e.g., experiments, field trips) with the intention of provoking specific reactions from the children. Teachers used the reactions of children as a gauge of how the science lessons were going and in turn, were driven by the goal of exciting the children and providing them with an experience they will remember when implementing these science experiments. This motivated them to consistently chose one-and-done experiments that exhibited some kind of “wow factor” (explosion, slime, etc). Doing so may be connected to the fact that teachers expressed personal enjoyment in science when children were engaged. If teachers have a previous personal experience or perception that science is boring, they may gravitate towards activities that “wow” children but objectively have little science application and learning for a preschooler. This is concerning because while these types of “one-and-done” experiments may be memorable, they may not always be quality science activities that influence the development of valuable skills. As a field, we need to address and distinguish between “real science” and “one-and-done experiments.” Discussing the notion that the captivating nature of these experiments may lack future applicability for science might be an important topic of discussion within teachers’ future professional development sessions or seminars.

Many teachers reported not feeling prepared to implement science in a way that is appropriate for the preschool classroom. Prior research hints that early childhood teachers lack preparedness to implement science lessons in the classroom (Greenfield et al., 2009). When unprepared to cater to all developmental levels, teachers were less likely to implement a lesson in the classroom. Prior research suggests that when implementing lessons in a preschool classroom, teachers should be equipped to provide differentiated learning opportunities for students based on cognitive and social development, which could be difficult if teachers do not feel properly supported or prepared (Elkin et al., 2016). Additionally, in order to assess each child's unique needs as well as their prior knowledge, experiences, and interests, a developmentally appropriate curriculum should also provide a variety of experiences, materials and equipment, and teaching strategies (Copple & Bredekamp, 2009). When teachers are unable to provide developmentally appropriate lessons within the science curriculum, children are more likely to turn away from science and become overwhelmed with the subject, motivating a negative perspective of science. Being prepared to meet the children where they are, provides the children with the most productive learning atmosphere, allowing them access to information that is appropriate to their level of understanding that further facilitates future application of science. Teachers who lack self-efficacy may not be ready to meet students where they are, which justifies the need for specialized training and ongoing professional development opportunities. Helping teachers become more confident in this domain may improve their self-efficacy and the regularity with which they incorporate preschool science.

Limitations and Future Directions

Despite the fact that the teachers interviewed came from a wide geographic area of the state, due to the qualitative nature of this study, the conclusions are not generalizable outside the NC Head Start teachers who participated in the study. The majority of the teachers in this study were primarily female and mostly White or Black/African American, limiting the study's ethnic and gender diversity. However, the study demographics do mirror the general demographics of Head Start teachers, who are predominately female, 56.30% White, and 35.14% Black. Additionally, because the study's focus on science education and food-based learning was made clear during interviews, those who were more interested in these subjects may have been more willing to participate and provided different perspectives than those who were less likely to do so. Despite its limitations, purposive sampling was thought to be the best technique for working with a target population that is readily available, accessible geographically, and willing to engage in the study (Etikan et al., 2016). A study like this could be easily replicated across the nation for wider generalizability of the results.

Furthermore, the use of telephone interviews in the current study made it difficult to observe each participant's nonverbal behavior or social cues. Considering this limitation, responses from interviewees are susceptible to less detail than could have been acquired from face-to-face interviews (Burnard, 1994). However, when gathering data from individuals who are not located in the same geographic area, telephone interviews have been found to be one of the most effective methods (Ariza-Ariza, 2013). In light of this, telephonic interviews might be able to better capture the interpretation of responses than other techniques of data collection, such as paper surveys (Ariza-Ariza, 2013). Lastly, participants' responses to the study could have been influenced by social desirability bias, making participants' classroom practices appear more or less desirable. We used strategies to limit this effect including introducing the study, building rapport, maintaining confidentiality, and asking follow-up questions (Bergen & Labonté, 2020). Future studies could utilize face-to-face interviews or focus groups to circumvent some of the methodological issues stated within this study.

Implications

To effectively prepare teachers to implement science education in the classroom, it is essential to understand the experiences and preparedness of early childhood teachers who teach science along with the connection to their classroom practices. HS Teachers highlighted how their own experiences affected how they chose to address science in the preschool classroom. Understanding the influence of these prior notions and experiences provides insight into what types of support may be beneficial for HS teachers in reference to this domain. Additionally, it is essential for teachers to be able to analyze their own experiences and comprehend how these experiences influence the way they teach. It is important for teachers to be aware that the classroom experiences they provide have an impact on how their students see the topic because HS teachers reported that their early experiences with science had influenced the way they approached the subject. These findings are essential to provide improved support, professional development opportunities, and experiences for early childhood teachers.

One of the challenges mentioned by HS teachers was the feeling of having insufficient resources and the need to use their own funds to purchase supplies for the classroom. Since teachers believe that this age group learns best through demonstration, the perceived need for physical resources appears to be consistent. Thus, providing teachers with enough resources to support science education within their respective classrooms should be prioritized by Head Start and funding for the same should be made available.

Additionally, teachers expressed value in the availability of professional development (PD) opportunities. PD that specifically provided them with a variety of learning opportunities and increased their confidence in teaching abilities. According to Elm & Nordqvist (2019) an effective professional development opportunity is one that aims to improve teachers' professional practice by supporting the development of instructional strategies and providing teachers with the materials and tools to thoroughly reflect on their individual and collective experiences. Thus, high quality professional development that can enhance teacher's self-efficacy in science and should be given continued importance within the Head Start settings.

Conclusion

This study observed and described the experiences of 35 Head Start teachers with science education in the preschool classroom through qualitative interviews. Science was chosen as the domain since it was proven to be the lowest-achieving learning domain, yet it is still becoming more important for expanding fields of employment. In order to better understand their perspective and approaches for integrating science in the preschool classroom, HS teachers expressed experiences of their own childhood, educational background, and personal experiences. Understanding what motivates early childhood teachers to implement the domain of science in their classrooms has implications for the early childhood field, future professional development opportunities, as well as the quality of education that is made available to young children.

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APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL

EAST CAROLINA UNIVERSITY University & Medical Center Institutional Review Board 4N-64 Brody Medical Sciences Building· Mail Stop 682 600 Moye Boulevard · Greenville, NC 27834 Office 252-744-2914 · Fax 252-744-2284 · rede.ecu.edu/umcirb/

Notification of Continuing Review Approval: Expedited

From: Social/Behavioral IRB
To: Virginia Stage

CC:

Date: 10/28/2021

Re: CR00009471
UMCIRB 18-002749
PEAS (Preschool Education in Applied Sciences)

The continuing review of your expedited study was approved. Approval of the study and any consent form(s) is for the period of 10/28/2021 to 10/27/2022. This research study is eligible for review under expedited category # 7. The Chairperson (or designee) deemed this study no more than minimal risk.

As the Principal Investigator you are explicitly responsible for the conduct of all aspects of this study and must adhere to all reporting requirements for the study. Your responsibilities include but are not limited to:

1. Ensuring changes to the approved research (including the UMCIRB approved consent document) are only initiated with UMCIRB review and approval except when necessary to eliminate an apparent immediate hazard to the participant. All changes (e.g. a change in procedure, number of participants, personnel, study locations, new recruitment materials, study instruments, etc.) must be prospectively reviewed and approved by the UMCIRB before they are implemented;

2. Ensuring that only valid versions of the UMCIRB approved, date-stamped informed consent document(s) are used for obtaining informed consent (consent documents with the IRB approval date stamp are found under the Documents tab in the ePIRATE study workspace);

3. Promptly reporting to the UMCIRB all unanticipated problems involving risks to participants and others;

4. Applying for continuing review and receive approval of continuation of the study prior to the study's current expiration date. Application for continuing review should be submitted no less

than 30 days prior to the expiration date. Lapses in approval (i.e. study expiration) should be avoided to protect the safety and welfare of enrolled participants and liability to the University; and

5. Submission of a final report when the study meets the UMCIRB criteria for closure. Study approval should not be allowed to expire simply because the study is completed, rather the UMCIRB should be formally notified of study completion via the final report process. The approval includes the following items:

Document Description

Addendum to Amendment #7 - Summary of Changes(0.01) Study Protocol or Grant Application

Amendment #10 - Summary of Changes.docx(0.02) Study Protocol or Grant Application

Appendix A Edu Manager Survey 071320.docx(0.01) Surveys and Questionnaires
Appendix A_Education Manager Survey UPDATED 100820.pdf(0.01) Surveys and Questionnaires

Appendix B Edu Coord Recr Flyer jmb.pptx(0.01) Recruitment Documents/Scripts

Appendix C Educ Coordinators_Email_Script jmb.docx(0.01) Recruitment Documents/Scripts

Appendix D Ed Coord Survey Consent.docx(0.01) Consent Forms
Appendix E Teacher Survey 071320.docx(0.01) Surveys and Questionnaires
Appendix F Interview-Survey Teachers Informed Consent.docx(0.01) Consent Forms

Appendix G Teachers_Email_Script PEAS .docx(0.01) Recruitment Documents/Scripts

Appendix H Teacher Recr Flyer 062420.pptx(0.01) Recruitment Documents/Scripts

Appendix I TEACHER_InterviewGuide 071320.docx(0.01) Interview/Focus Group Scripts/Questions

Appendix J PLC Teacher Recr Flyer Interview 7.7.20.pptx(0.01) Recruitment Documents/Scripts

Appendix J PLC Teacher Recr Flyer Interview REVISED 032721.pptx(0.01) Recruitment Documents/Scripts
Appendix K PLC_Teachers_Email_Script PEAS Interview ADP 7.7.20.docx(0.01) Recruitment Documents/Scripts
Appendix K PLC_Teachers_Email_Script PEAS Interview REVISED 032721.docx(0.01) Recruitment Documents/Scripts
Appendix L HPLC Interview Teacher Consent REVISED 032621(0.02) Consent Forms
Appendix L HPLC Interview Teachers Informed Consent 7.7.20.docx(0.01) Consent Forms

Appendix M HPLC_TEACHER_InterviewGuide_7_7_20.docx(0.01) Interview/Focus Group Scripts/Questions

Appendix N PreschoolScienceMaterialsCheck UPDATED 100820.pdf(0.01) Surveys and Questionnaires
Appendix N Tu Tool Revised 062520.docx(0.01) Surveys and Questionnaires
Appendix O STEBI.docx(0.01) Surveys and Questionnaires
Appendix P ORIC Survey Formatted.doc(0.01) Surveys and Questionnaires
Appendix Q Cog Interview Teachers Informed Consent.docx(0.01) Consent Forms

Appendix R Cognitive Interview Guide.docx(0.01) Interview/Focus Group Scripts/Questions

Education Manager Original Consent Summary in REDCAP.docx.docx.docx(0.01) Recruitment Documents/Scripts
Education Manager Study Summary NEW Text for REDCap Survey 100820.docx(0.01) Recruitment Documents/Scripts
Education Manager Survey Eligibility Screener 100820.docx(0.01) Surveys and Questionnaires
Letter to Participant - Notice of Compensation Change for PLC Survey & Interview(0.02) Consent Forms

NIH SEPA Grant - PEAS 2018(0.01) Study Protocol or Grant Application

PEAS Needs Assessment Protocol- March 2021 032621.docx(0.02) Study Protocol or Grant Application
PEAS Needs Assessment Protocol- May 2020 071320.docx(0.03) Study Protocol or Grant Application
Summary of Amendment #8 Changes October 2020.docx(0.01) Study Protocol or Grant Application

Teacher Sci Ed Survey Original Consent Summary in REDCAP.docx.docx(0.01) Recruitment Documents/Scripts
Teacher Sci Educ Eligibility Screener 100820.docx(0.01) Surveys and Questionnaires
Teacher Sci Educ Study Summary NEW Text for REDCap Survey 100820.docx(0.01) Recruitment Documents/Scripts

For research studies where a waiver or alteration of HIPAA Authorization has been approved, the IRB states that each of the waiver criteria in 45 CFR 164.512(i)(1)(i)(A) and (2)(i) through (v) have been met. Additionally, the elements of PHI to be collected as described in items 1 and 2 of the Application for Waiver of Authorization have been determined to be the minimal necessary for the specified research. The Chairperson (or designee) does not have a potential for conflict of interest on this study.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418

IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

APPENDIX B. HEAD START RECRUITMENT SCRIPT

Hello, is this [NAME OF PROGRAM] Head Start? Wonderful. May I speak with your education manager?

If asked to identify self: My name is ________________ and I work East Carolina University in the Food-based Early Education Lab, FEEd for short.

If after transferred, you get a voicemail, write down Education Manager's Name (from Voicemail) ___________________________________

Then leave Voice Mail:

Good morning/afternoon! My name is ____________ and I work at East Carolina University in the Food-based Early Education Lab, FEEd for short. We've recently received a National Institutes of Health grant to support the development of science education resources for Head Start programs in NC. Right now, we are in the process of conducting a needs assessment to make sure we are meeting everyone's needs. We would love to include [NAME OF PROGRAM] to ensure we are meeting your needs too. If you have a few minutes to chat, please give me a call back at __________________. Hope you have a wonderful day!

If Education Manager Answers: Hi! My name is ____________

and I work at East Carolina University in the Food-based Early Education Lab, FEEd for short. . How are you doing today?

[Small Talk]

Well great! I'm calling because we've recently received a National Institutes of Health grant to support the development of science education resources for Head Start programs in NC. Right now, we are in the process of conducting a needs assessment to make sure we are meeting everyone's needs. We would love to include [NAME OF PROGRAM] to ensure we are meeting your needs too. Do you have a few minutes to chat?

If no: Okay, I understand. Thank you for your time. I hope you have a wonderful day!
If they say they need to talk to their director first: Okay! If it's easier, I can call and talk with your director directly if that would be helpful?
If they say they would like you to talk to director: That is no problem. Can I get their name and phone number please? ____
NOTE: If you are not able to get Director name/info, you should be able to look up online

If yes: Wonderful! Right now, we are doing a needs assessment to explore programs current science education practices, training opportunities, and classroom resources. This information will help us know how to best serve different programs across the state. We're collecting information through online surveys and interviews. For you as the education manager we have an online survey. For teachers, we have an online survey and an opportunity to also participate in a telephone interview.

If your program is interested in participating, we can also send you a summarized report of our findings in time for inclusion in your annual report for next year.

After this needs assessment, our next steps will be to develop a professional development for teachers that reflects what they actually want and need! Then, over the next few years, we will continue to partner with Head Start programs across the state to implement these professional development opportunities to support STEM learning in your classrooms!

Does this sound like something you would be interested in?

If no: Okay, I understand. Thank you for taking the time to talk to me anyways! I appreciate your consideration!
If yes: Great! To get started, we'd like to email your teachers to tell them about the opportunity to participate. We would only use their emails to send the survey and nothing else. Would this be okay?

If no: Okay, I understand. Would you be comfortable if I compose the email and send it to you and you could forward it to your teachers and cc me on it so they can reach out if they are interested?
If yes: Wonderful. Let me give you the email to send the list to – it's carrawaystagev@ecu.edu

And then if you would be willing to participate in the online survey for education managers, I can send that to you via email as well. Would you be willing to share your insight with us as well?

If no: Alright, no problem!
If yes: Great! What is your email address? ______________________________

I think that is everything for now. Thank you again for taking time to talk with me! I will be reaching out to you/your teachers in the near future. If you think of any questions or comments for me, please do not hesitate to reach out. My phone number is _______________. You can also reach the director of the FEEd Lab, Virginia Stage at 252-744-1001 with any questions or concerns. I hope you have a wonderful day!

Possible Questions:

What about incentives? How will teachers be compensated for their time? Will this be paid?
Both teachers and education manager who complete the online survey be compensated for their time by being entered into a drawing for a gift card. Teachers who complete a telephone interview will be compensated with a $30 gift card because this is outside the scope of the requirements for their job. Also, I want to emphasize that none of these things are an assessment

of you, your teachers, or your program. We are simply trying to deepen our understanding of what the current state of STEM learning is in the classroom.

How long are the surveys? What is the time commitment?
We know everyone is very busy these days. The surveys are short, they take about 20 minutes to fill out and it's all online. The optional interviews that teachers can participate in take around 45-60 minutes.

NOTE: If you are asked a question you don't know the answer to, if you can text Stage (910-494-5406) discreetly while on phone OR say you are unsure of the answer but can find out and give a call back.

Other Questions Asked:

APPENDIX C. HEAD START TEACHER INTERVIEW RECRUITMENT FLYER

APPENDIX D. STATEWIDE TEACHER SURVEY/INTERVIEW CONSENT FORM

Title of Research Study: Understanding the State of Science in North Carolina Head Start Programs: A Needs Assessment

Sponsor/Funding Source: National Institutes of Health (NIH), National Institute of General Medical Sciences, Science Education Partnership Award

Principal Investigators: Virginia C. Stage, PhD, RDN (Persons in Charge of this Study)
Department or Division: Department of Nutrition Science
Address: Health Sciences Building (Suite 2307), East Carolina University Greenville, NC 27858
Telephone #: 252-744-1001

Researchers at East Carolina University (ECU), North Carolina State University (NCSU), University of North Carolina at Greensboro (UNCG), and North Carolina A&T (NC A&T) study issues related to society, health problems, environmental problems, public policy, behavior problems, and the human condition. To do this, we need the help of volunteers who are willing to take part in research.

Study Summary

This purpose of this study is to gain a clearer understanding of Head Start programs' needs, assets, and resources related to science education. The information obtained in this study will assist researchers in creating teacher professional development resources that align with the needs of North Carolina-based Head Start Teachers. Eligible participants must be over the age of 18 years and currently employed as a Lead or Assistant Teacher in a North Carolina Head Start program. If you choose to take part in this study, you will be asked to complete a survey, or a survey and interview (optional). In the first part of the study you will be asked to complete an online survey that will take approximately 15 to 20 minutes. During the second part you will be given the opportunity to also participate in one 45 to 60 minute telephone interview. At the conclusion of the interview, the researcher will take approximately 10 minutes to review a brief written summary of the interview with you and ask you to confirm accuracy or correct inaccuracies of our interpretation of the interview. There are no known risks (the chance of harm) associated with this research. Any risks that may occur with this research are no more than what you would experience in everyday life. If you are interested in learning more about this study, please continue to read the information below.

Why am I being invited to take part in this research?
You are being asked to take part in this research because you are a Head Start Teacher (Lead or Assistant) in North Carolina. To help us better understand what is happening around science and nutrition education, this research will consist of two parts:
● **PART I (Survey):** You will be asked to complete an online survey about (1) science education in the classroom, how you talk about science with children, and food-based learning,(2) teacher training and professional development, and (3) priority of science education in the classroom. You will also be provided with the opportunity to complete an optional survey about your experience with COVID-19's (the coronavirus disease caused by the severe acute respiratory

syndrome) impact.
● **PART II (Interview):** You will be asked to complete a telephone interview. In the interview we will discuss your experiences, challenges, and needs related to science and nutrition education practices with 3-5-year-old children in your Head Start program.

The decision to take part in this research is yours to make. By doing this research, we hope to gain a clearer understanding of North Carolina Head Start programs specific needs, assets, and resources related to science learning environments. Findings from this research will enable our team to create teacher professional development resources related to science and nutrition education that align with the needs of North Carolina-based Head Start teachers.

If you volunteer to take part in this research, you will be one of about 100 people across the state of North Carolina to do so.

Are there reasons I should not take part in this research?
Participants must be over the age of 18 years and employed as a Teacher (Lead or Assistant) within a Head Start program in North Carolina.

What other choices do I have if I do not take part in this research?
You can choose not to participate in this research. Choosing not to participate in the study will not affect your relationship with your work site or ECU, NCSU, UNCG, or NC A&T.

Where is the research going to take place and how long will it last?
The research will be conducted via an online survey with the option of also completing an interview over the phone. The online survey can be completed any time before the scheduled telephone interview. Online surveys can be completed at a place of your choosing. If you choose to also participate in the interview, a specific date and time for the interview will be scheduled during a time that is convenient for you. The total amount of time you will be asked to dedicate to this study is no more than 90 minutes: 15-20 minutes for the online survey, 45-60 minutes for the telephone interview, and 10 minutes reviewing the summary of your interview.

What will I be asked to do?
You will be asked to do the following:
1. Complete a 50-item online survey with an option 28-item add-on survey about COVID-19. The survey is broken down into the following sections:
Section A: Science Education Practices (11 items)
Section B: Training & Professional Development (25 items)
Section C: Priority for Science Education, Science Talk with Children, & Food-based Learning (4 items)
Section D: Tell Us About Yourself (10 items)
Section E: Your Experiences with COVID-19's Impact (28 items) (Optional Survey)

2. Complete one 45-60-minute telephone interview about science and nutrition education practices in your classroom, training and professional development practices, and priority level for science and nutrition education in the classroom.

3. Review a brief written summary of the interview and confirm accuracy or correct inaccuracies of our interpretation of the interview.

What might I experience if I take part in the research?
We don’t know of any risks (the chance of harm) associated with this research. Any risks that may occur with this research are no more than what you would experience in everyday life. We don't know if you will benefit from taking part in this study. There may not be any personal benefit to you, but the information gained by doing this research may help others in the future. Your specific responses will not be shared with your respective employers or other government agencies.

Will I be paid for taking part in this research?

You will receive a $30 gift card as compensation for your time for completing both the survey and interview.

If you choose to complete only the survey, you will be entered into a drawing for a $95 gift card.

If you choose to complete the optional questions about COVID in the survey (Section E), you will be entered into a second drawing for a $95 gift card.

You will be entered separately for each raffle. Each person has a separate and equal chance to win. However, to ensure fairness, one individual will not be eligible to win both raffles. Raffle winners will be notified at the of the study (Spring 2021).

Will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
ECU, NCSU, UNCG, and NC A&T and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may also use your private information to do this research:
● The sponsors of this study (National Institutes of Health)
● The University & Medical Center Institutional Review Board (UMCIRB) and its staff have responsibility for overseeing your welfare during this research and may need to see research records that identify you.

How will you keep the information you collect about me secure? How long will you keep it?
Data from the surveys will be stored electronically on the PI’s Pirate Drive (an online, password-protected, secure storage folder accessible only by the study team members). All computers with access to the Pirate Drive are password protected and available only to authorized personnel. Hard copies of data (e.g. transcribed interviews) will be stored in a locked file cabinet in a locked office in Health Sciences Suite 2703. Within three years after the conclusion of the study, survey files and the digital recordings will be erased. Participants’ name, phone number, and email address will be recorded so we can remind the

participant of the time and location for the in-depth interview (if applicable), however, this information will be stored separately from de-identified data. Participants will be given an identification number. Further, code names will be used for interviews. Traditionally, no identifying information is included in the interview, but the participant might inadvertently reveal identifying information that will be de-identified on any transcripts produced from the audio recordings. The use of a pseudonym will help ensure participants cannot be identified from the interview recording after it has been de-identified.

What if I decide I don't want to continue in this research?
You can stop at any time after it has already started. There will be no consequences if you stop and you will not be criticized. You will not lose any benefits that you normally receive.

Who should I contact if I have questions?
The people conducting this study will be able to answer any questions concerning this research, now or in the future. You may contact Virginia C. Stage at 252-744-1001 (Monday-Friday, between 8:00A and 4:00P).

If you have questions about your rights as someone taking part in research, you may call the University & Medical Center Institutional Review Board (UMCIRB) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director for Human Research Protections, at 252-744-2914.

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

● I have read (or had read to me) all of the above information.
● I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
● I know that I can stop taking part in this study at any time.
● By signing this informed consent form, I am not giving up any of my rights.
● I have been given a copy of this consent document, and it is mine to keep.

____

Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above and answered all of the person's questions about the research.

____

Person Obtaining Consent (PRINT) **Signature** **Date**

APPENDIX E. QUALITATIVE INTERVIEW GUIDE OPENING

1| **OPENING**

Hello, [insert teacher or administrator name]. We've been emailing, but in case we haven't met yet, my name is __________________ and I'm a research assistant at ECU. How are you doing today? [Small Talk]

Great!

Well I first want to thank you for your time! Before we start, I'm going to go over some logistics of the interview and just so you know, this part is a little awkward so hang with me and we'll get our conversation going soon! Does that sound good?

I'm excited to talk with you today because our goal is to learn more about science learning environments for 3-5-year-olds in your Head Start classroom. I really want to focus on your experiences, challenges, and needs related to science learning in your classroom.

Now I'm sure that COVID-19 may have changed some of what you do in your classroom. So we'll focus our conversation on your experiences **prior** to the impact of COVID-19. And as a refresher, in North Carolina, COVID-19 appeared at the beginning of March 2020, so think about the time period **before** that date. But just so you know, at the end of our conversation you'll have a chance to talk about changes that have happened related to COVID-19, so there will be time to talk about COVID-19 as well. ☺

That all sound good?

Wonderful! Now as a reminder, your participation in this study is completely voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time without penalty. Your choice to participate in this study, or not, will not affect your relationship with your work site, ECU, NCSU, UNCG, or NC A&T.

If this all still sounds good, and you still agree to participate, our interview will last about 45-60 minutes. At the end of the interview I'll take about 10 minutes to review what we discussed to make sure I got everything right. If you can, find a quiet place to sit during our talk. And just so you know, I will be taking notes and will also audio-record the session. So if you hear silence on my end, I'm here either taking notes or taking a sip of water. ☺

Do you have any questions so far?

Great! We're almost ready to go!

[Audio recorder]: As previously mentioned, I'd like to use an audio recorder during the discussion so that I can refer back to the discussion when I write my research report. Do you mind if I record this interview session?

a . (NO) Thank you!

b . (YES) OK. I'm afraid we have to audio record the interview. Because of that, you will not be able to participate in the interview today. Thank you for your time.

[PRESS BUTTON HERE]

Alright, it's on. We're recording! ☺

Now before we start, can you give me an **alternate name** for yourself? Basically, make up a name that's not your real name so that your real name is never recorded. Do you have a name I can call you?

Great! Let's get started [insert name]!

2|

INTERVIEW

Okay [name], we'll start off with some fun questions to get our conversation going.

And again, I am interested in hearing about your experiences when you are teaching science in your classroom prior to March when COVID-19 began in North Carolina. With that in mind, please give me a lot of examples and tell stories. No information is too simple or too complex and there are no right or wrong answers. But when you tell stories, please do not refer to people in your stories by their real name. You can make up an name for that person or refer to them by their relationship to you.

Any questions before we start?

INTRODUCTORY QUESTIONS

1. Prior to COVID-19, what was your favorite thing about science to teach preschoolers and why?

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

2. What comes to mind when you hear the words preschool science education?

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

PRIOR TRAINING/EXPERIENCE IN SCIENCE EDUCATION

Transition: Thank you for sharing! Okay, for the first topic, let's talk about the types of training and experiences you've had in teaching preschoolers about science in your classroom.

3. Can you tell me about any types of training you've had in teaching preschoolers about science?

✓	**REQUIRED PROBES**	**OPTIONAL PROBES**	**GENERAL PROBES**
	a. Have any of these or other trainings included how to ***talk about science*** with preschool children? If <u>yes</u>: Can you tell me more about that training? If <u>no</u>: "Okay." b. Have any of these trainings included how to ***use food as a tool*** to teach preschool children about science? If <u>yes</u>: Can you tell me more about that training? If <u>no</u>: "Okay."	Where did you have this training? Who provided this training? **NOTE:** Use only if participant does not state where training(s) occurred or (e.g. in-service, college courses, licensure)	Can you describe this training more? Can you describe that experie more? Can you tell me more about t

Optional Probe: Use only if participant does not state where training(s) occurred or (e.g. in-service, college courses, licensure)

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

CURRENT PRACTICES IN SCIENCE EDUCATION

Transition: Thanks for sharing that! For the second topic, let's talk about what was happening with science education in your classroom prior to the impact of COVID-19.

Science Activities & Lessons

4. To start, can you describe some activities or lessons that you've used in the past school year, <u>prior to COVID-19,</u> to teach children about science?

✓	REQUIRED PROBES	OPTIONAL PROBES	GENERAL PROBES
	a. What are some factors that influenced which science activities or lessons you taught prior to COVID-19?	<u>Use if asked for clarification:</u> Think about the types of science activities you did in the classroom prior to COVID-19.	Can you think of anything else? Can you tell me more abou this? Can you think of anything else?
	b. Can you give me an example of your favorite science lesson or activity you used prior to COVID-19?		
	c. How did you know when you were doing a good job of <u>**teaching**</u> about science?	What types of materials were needed?	
	d. How did you know when you were <u>**struggling**</u> to do a good job teaching about science?	Was this lesson or activity from a curriculum? If so, do you know which curriculum it was?	
	e. How did your standard of determining if you were doing a good job or struggling compare to what your supervisor expected of you? **NOTE:** This probe can seem like an assessment, be sure to respond with "Okay, great! Thanks for sharing that ☺"	**NOTE:** This probe can seem like an assessment, be sure to respond with "Okay, great! Thanks for sharing that ☺"	

Optional Probe 1: Use only if participant does not describe materials used in the pre-planned activity they describe.

Optional Probe 2: Use only if participant does not state that the lesson was from a curriculum and/or do not state which curriculum it was from.

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

5. When you talked to children about science prior to COVID-19, what did you talk to them about?

✓	REQUIRED PROBES	GENERAL PROBES
	a. Thanks for sharing that! Before COVID-19, what would you say influenced your "*Science* Talk" or how you talked about science with children? Just as a reminder, "*Science Talk*" is simply engaging children in scientific discussion using scientific practice words like observe, describe, compare, predict, experiment, reflect. Science talk can happen with any topic related to science. So again, the question is, before COVID-19, what influenced your "*Science* Talk" or how you talked about science with children? [**NOTE:** Allow participant to describe what they talk about before providing the definition of science talk.	Can you think of anything else? Can you give me another example about this? Why or why not?

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

6. Now that we have discussed science learning in detail, can you describe any activities or lessons you've done prior to COVID-19, that combine science with other subjects?

✓	REQUIRED PROBES	OPTIONAL PROBES	GENERAL PROBES
	a. If yes: Can you give me an example of how you have combined multiple subjects? If no: Okay.	If asked for clarification say: Think about the types of science activities, you have done in the classroom and what subjects they have involved.	Can you explain this mor Can you give another example?
	b. What **subject** was the primary focus of the lesson? [**NOTE**: Use if it is not clear from the description whether science was the primary or secondary focus. If teacher is still unclear on what asking, provide examples of subjects such as mathematics, language, art, science etc.]		

REVIEW PROBES - "*I heard you say….*"
Did I get that right?
Do you have anything else to add?

****CHECK TIME****

Supports & Challenges to Teaching Science

Transition: Thank you for sharing all of that, I'm learning a lot. Now we're going to talk about your supports and challenges to teaching science.

7. Can you list some things that have helped or supported you when you have taught science in the classroom prior to COVID-19? This can be people, places or things.

✓	REQUIRED PROBES	GENERAL PROBES
	a. I heard you list **[say what they listed as supports]** as supports, are there any others you would like to add?	Can you explain this more?
	b. Which of these supports you've listed do you think helped the most?	Can you think of anything else?
	c. How did having this help or support influence which activities or lessons you did in the classroom?	Can you give me an example?
	d. Can you give me a detailed example, like a story, about how **[list what they said was most helpful]** has helped you teach science with children prior to COVID-19?	Why or why not?

REVIEW PROBES - "*I heard you say….*"**
Did I get that right?
Do you have anything else to add?

8. Can you list some challenges you faced when doing science activities and lessons in your classroom prior to COVID-19? This can be people, places, or things.

✓	REQUIRED PROBES	GENERAL PROBES
	a. I heard you list **[say what they listed as challenges]** as challenges, are there any others you would like to add?	Can you explain this more?
	b. Which of these challenges you've listed do you think is the biggest?	Can you think of anything else?
	c. How did this challenge affect which science activities and lessons you did in the classroom prior to COVID-19?	Can you give me an example?
		Why or why not?

	d. Can you give me a detailed example, like a story, about how **[list what they said was most challenging]** has been a challenge for you while you taught science with children prior to COVID-19?	

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

Opinions & Motivators

9. In your opinion, what are some reasons you should engage preschool children in science?

✓	REQUIRED PROBES	GENERAL PROBES
	a. On the contrary, what do you think are some reasons you should not engage preschool children in science?	Can you explain this more? Can you think of anything else? Why or why not?

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

****CHECK TIME****

FUTURE STATE: CHANGES & PROGRAM/TEACHER NEEDS

Transition: Thank you for all your sharing so far about your experiences prior to COVID-19! We are on the last topic talking about your **present** needs and challenges. We want to create professional development resources that meet what your needs actually are. To do this, we need to know what, if any, changes are needed and any professional development opportunities that you would like to see in the future.

14. To start, what skills, experiences, or training opportunities do you feel you need to provide strong science education to your preschool-aged children?

✓	**REQUIRED PROBES**	**GENERAL PROBES**
	a. What are some science topics you might want to learn more about?	Can you explain this more? Can you think of anything else? Why or why not?
	b. What are some food experience topics you might want to know more about?	

REVIEW PROBES - "*I heard you say….*"
Did I get that right?
Do you have anything else to add?

15. Thanks for sharing that! We are now on our last question and so we'll flip to talk about your science classroom during COVID-19. So my question is, in what ways has COVID-19 already impacted your current science classroom?

✓	**REQUIRED PROBES**	**GENERAL PROBES**
	a. How might COVID-19 impact your use of science talk?	Can you explain this more? Can you think of anything else?

	b. How might COVID-19 impact your use of food experiences?	Why or why not?
	c. How else might COVID-19 impact your classroom as a whole?	

REVIEW PROBES - "*I heard you say…."*
Did I get that right?
Do you have anything else to add?

3|

REVIEW

Perfect! That ends our questions and so before we end, I'm going to take a few minutes to review what you've said. After each question I'm going to ask you if I got that right and if there is anything else you'd like to add. This is a very important step in the process to make sure we have the right information. Feel free to stop me at anytime and add anything that I may have missed.

NOTE: Watch time, do NOT keep them over.

If you are already over time: "You know what, I just looked at my watch and I've lost track of time!

If you want to ask them about going over to finish: All we have left is _________ which won't take more than _____ minutes. Would you like to finish this last question/review or end now?

If you feel need to end now: I don't want to keep you over so let's skip right to the end to get you your gift card."

If you are *almost* out of time but still have some or all of the reviews: Go through reviews but okay to move quickly, do NOT keep them over 60 minutes

4|

CLOSING

Alright, that ends the major part of our interview that we will be recording, so I have turned our recorder off and you are not being recorded.

Thank you so much for taking time to talk with me! I learned lots of things from you today! Our next step will be to transcribe our interview and summarize what we discussed. Would you be willing to review our summary once it is completed to make sure we interpreted everything correctly?

Yes: Great! Is it better for me to send you an email or a hard copy?

Thank you! What is your (email address/home address)?

____

No: Alright! Not a problem!

Lastly, what type of gift card would you like? We have Walmart, Target or Amazon? Great, would you like it sent electronically via email or a physical card? (Write email or address)

____

Thank you again for your help! You have been generous with your time! Have a great rest of the day!