From the Voices of Kindergarten Teachers: Factors That Impact Decisions about When to Engage the Natural Curiosities of Their Students in Science

by

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To my mom and dad, John and Brenda Cagle, for giving me life and love.

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Most importantly, to my God: Guide me into your truth and teach me. For you are the God who delivers me; on you I rely all day long. Psalm 25:5

ABSTRACT

Students enter kindergarten as natural-born scientists, curious about the world around them. They enter middle school disliking science. Although implementing science in kindergarten has the potential to improve learning in other subjects in addition to science, it is not taught much in kindergarten. There are many reasons for this according to the literature. The purpose of the study is to gain insight into teachers' thinking as they decide when and how to engage their students in science, to better understand why student enjoyment of science fades in early grades; to contribute teachers' voices to the existing literature on teaching science in the early grades; and to investigate how teachers' science teaching methods align with current research regarding how students learn best.

The key research question is "What are the factors that impact teachers' decisions about when to engage the natural curiosities of their students?" Broken down, the supporting research questions include: 1. What factors impact teacher decisions about when to teach science? 2. Under what conditions do teachers engage students' natural curiosities in science? 3. How do teachers describe engagement in their classrooms? This was a participatory action research study that used autoethnography, case studies, and grounded theory methods. Five co-researchers took part in the process. Purposeful sampling was used to select a range of kindergarten teachers in Tennessee and Alabama with different perspectives on teaching science—some from county systems and some from city systems; some using Alabama Math, Science, and Technology Initiative (AMSTI) kits and some not using kits. Co-researchers were selected during initial meetings, interviewed, collected journal entry data, and interviewed again at the

culmination of the study. Interviews were transcribed and coded. Analysis included individual cases, each co-researcher, as well as across-case analysis. Results indicated that co-researchers did not have time to teach science many days due to requirements for teaching reading and math, and because of benchmark testing. Recommendations include integrating science concepts including hands-on explorations with reading and math. Ideas for future study include collecting data for a full year, as opposed to eight weeks, to see how factors change from beginning to end in one school year. The idea of learning during spontaneous interactions emerged from interviews with two co-researchers. Exploring spontaneous interactions is another area for future study.

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CHAPTER ONE

INTRODUCTION

According to the revised edition of *Rising Above the Storm* (National Academies, 2010), America's ability to compete in the global marketplace for jobs either directly or indirectly related to science has deteriorated even further since the initial report by the National Academies in 2005. In addition, the most recent data from TIMMS (Trends in International Mathematics and Science Study) shows that in comparing fourth and eighth grade students, "substantially fewer eighth grade students reported positive attitudes toward learning science" (p. 17). Considering the fact that the average TIMMS score for students is 500, the achievement gap is widening "between students who like learning the subject (515, on average) and those who do not (450)" (2010, p. 17).

In contrast, young children enjoy science (Gerde, Schachter, & Wasik, 2013). Students enter kindergarten with their own understandings, which may be different from scientifically accepted ideas of the world (Henriques, 2002). Some groups of children enter kindergarten less knowledgeable about science than other groups, leading to knowledge gaps in first grade, following into third grade, and persisting into eighth grade (Morgan, et al., 2016). "If left unaddressed, and given the nation's increasing economic disparities, low science achievement may be experienced by growing segments of the U.S. adult population" (Morgan, et al., 2016, p. 30). Currently, time spent teaching science in elementary grades is declining even though we know instruction leads to achievement in science (Blank, 2013). Student interest in science declines by age 11, so science intervention in earlier grades is a "key time for building interest" (Blank, 2013, p. 832).

One way to build interest in the early grades is to recognize and build on students' natural curiosities. Spektor-Levy, et al. (2014) said "Curiosity motivates learning and academic performance: People who are more interested in given content spend more time reading a text, persist longer at the learning tasks, process the information more deeply, remember more of what they read and get better grades in class."

This study looks at factors that impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science. Through experiences as an educator, the researcher has seen students enter kindergarten eager to explore their world through science, yet arrive in middle school believing science is difficult and they are not good at it, nor do they enjoy it. Implications for conducting this study include adding to the current literature in understanding when kindergarten teachers teach science and why they teach it when they do, how they teach science, whether it is taught in isolation or integrated with other subjects, and factors that impact their decisions about engaging students' natural curiosities in science. According to the literature, several factors impact teachers' decisions about teaching science. They include teachers' perceptions of student abilities, teacher abilities, lack of materials, and teacher accountability and curriculum factors.

In chapter one, the researcher gives an autoethnographic perspective describing experiences in education and how it relates to current literature, showing the importance of the study. Next, the researcher addresses the problem description and purpose of the study, followed by a description of the research question and theoretical framework for the study.

Background and Current Literature

Positive attitudes towards science decline in middle and high school (Spektor-Levy, Baruch, & Mevarech, 2014). For this researcher, experiences teaching in a middle school brought a realization that students often enter middle school disliking science. In contrast, young children enjoy science (Gerde, Schachter, & Wasik, 2013). This was evident during investigations with preschoolers in Germany, in which children were active in many structured experiences as well as spontaneous interactions. A trip to the playground turned into discovery, releasing objects down the slide to see if they would roll, slide, or stop, and how quickly due to the impact of friction. "It is through active engagement with science that children develop concepts of themselves as science learners and participants in the process of science" (Mantzicopoulos, Patrick, & Samarapungavan, 2008, p. 379). These experiences and the children's reactions were a prominent factor in the researcher's decision to work in the field of education.

Comparing the levels of enjoyment of two groups, Pre-K and middle school, shows that something happens to children between the preschool years and sixth grade. The researcher gained insight into this phenomenon while working as an administrator in an elementary school. In this autoethnographic study, the researcher merges experiences as a middle school science teacher with work as a preschool teacher and monitor of science instruction in the early grades, to explore what happens to students their first year of primary school.

In an administration role at a pre-kindergarten through fourth grade school in Tennessee, the researcher recognized that even though kindergarten students started their first year of school as "natural-born scientists" (NRC, 2012; Mantzicopoulos, Patrick, &

Samarapungavan, 2008), they spent most of their time sitting at tables working on reading and math worksheets and activities. This coincides with research which states that although children enjoy science, its role in the kindergarten curriculum is minimal (Henrichs & Liseman, 2014). From the researcher's observations, when science was taught it was usually done by reading a story that was either not relevant or only superficially related to what students were experiencing at the time. For example, reading a book about butterflies counted as science for the day. They read the book because the class was studying the letter "B," not because they had been outside and saw a butterfly, bringing up "I wonder" questions. The class was not involved in an in-depth study about butterflies. This isolated instruction shows a lack of "conceptual coherence or continuity across science topics," which is a trend across the nation (Patrick, et al., 2009, p. 183). From observations as an administrator, instead of taking students' natural curiosities about science and using it as a vehicle to teach reading and math, the natural behavior was not acknowledged and students sat at tables completing worksheets. When attempts were made to teach science, they tied it to reading concepts, with little meaningful exploration involved. According to Mantzicopoulos et al. (2008), when teachers attempt to integrate science into reading, the focus is more on reading than science because teachers are more comfortable teaching language arts.

In contrast, currently working in Alabama, the researcher has been exposed to a state program in which kits are rotated among participating schools. In order to utilize the kits, teachers must attend professional development for ten days, five for science and five for math. Additional support is provided throughout the year by regional university faculty. Working in different schools belonging to different school systems in northern

Alabama, the researcher has observed teachers using these kits to instruct. Discussions with a teacher who taught in Tennessee, where kits were not available, and then taught in Alabama where the kits were used revealed that using the kits gave the teacher more confidence and made teaching science convenient. The availability of science materials "encourage[s] teachers to teach specific science content." (Sackes, 2012, p. 180). The kits include many types of exploration experiences. During the observations teachers adopting the kits appeared more confident in teaching science, which could be due to the training that goes with using the kits. Participating in in-service science courses that include pedagogical content knowledge "might contribute to the increase in the frequency of science teaching in kindergarten" (Sackes, 2012, p. 180). The researcher has witnessed some of this training, as much of it is incorporated into the methods courses for pre-service teachers in the building of the university in which the researcher works.

Problem Description

Time spent teaching science in the elementary classroom is declining even though we know instruction leads to achievement in science (Blank, 2013). Blank (2013) states that the early grades are a key time to build student interest. Henrichs and Leseman (2014) state that science instruction in the early grades should lay the foundation for scientific learning concepts and scientific thinking. Although young children enjoy science, its role in the curriculum is minimal (Henrichs & Leseman, 2014).

In consideration of the above, the following question emerged: "What are the factors that impact teachers' decisions about when to engage the natural curiosities of their students?" After contemplating which grades to include—kindergarten through second, or just kindergarten—the researcher decided to focus on kindergarten because

that is where students enter school with natural curiosity, and curiosity "wanes, instead of waxes" as students remain in school over time (Engel, 2011, p. 633). Therefore, it is necessary to gain insight into when and why kindergarten teachers teach science in the manner they do and how teacher methods align with current research regarding how students learn.

Purpose of the Study

According to the National Science Teachers Association, "inquiry science must be a basic in the daily curriculum of every elementary school student at every grade level" (NSTA, 2002, no page number). Children develop an understanding of science as a discipline, and find an interest in science through active engagement (Mantzicopoulos, Patrick, & Samarapungavan, 2008). This dissertation project was a participatory action research study that used autoethnography, case studies, and grounded theory methods that focused on the following questions: 1. What factors impact teacher decisions about when to teach science? 2. Under what conditions do teachers engage students' natural curiosities in science? 3. How do teachers describe engagement in their classrooms? By conducting this study, the intent is to gain insight into teachers' thinking as they decide when and how to engage their students in science, in an effort to better understand why student enjoyment of science fades in early grades; to contribute teachers' voices to the existing literature on teaching science in the early grades; and to investigate how teachers' science teaching methods align with current research regarding how students learn best. The project adds to the current literature that supports the need for kindergarten teachers to teach science in a manner that will best build students'

understanding of science. Furthermore, the study goes beyond the current literature by bringing the voices of kindergarten teachers into the research.

Primary research question: What factors impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science?

Theoretical Framework

The theoretical proposition is that if more time is spent building on the natural curiosities of students instead of isolated instruction out of context, students would better understand and enjoy science. PISA (Programme for International Student Assessment) results suggest that students' enjoyment of science is "positively associated to students' science performance" (2007, p. 145). Tapping into students' natural curiosities provides opportunities to build on experiences and structures to lay solid foundations for science. "When curiosity rather than a script guides their actions, children not only stay interested but also develop an understanding of the scientific method" (Engel, 2011, p. 628).

The researcher views the study through the eyes of a former science educator who questioned the lack of motivation among middle school science students until experiences in an elementary school revealed the absence of science instruction in lower grades. The researcher believes that teachers strive to do what is best for students, which led the researcher to question why teachers are not teaching science when research supports the importance of science instruction.

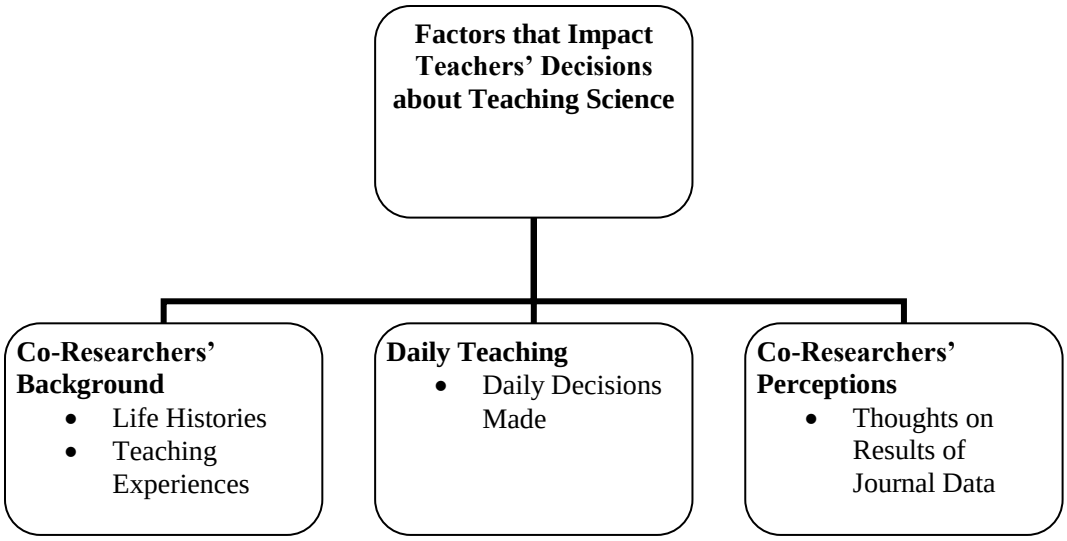


Figure 1. Theoretical Model for Factors Impacting Teacher Decisions

Note: Data collection consisted of initial interviews, journal entry data, and culminating interviews to learn about each co-researcher's background, teaching decisions, perceptions of data gathered, and insights about the study.

Definition of Terms

In this study, the term "natural curiosities" means "interest that leads to inquiry occurring within the ordinary course of nature." According to Merriam-Webster curiosity means "interest leading to inquiry" and natural means "usual or expected" or "occurring in conformity with the ordinary course of nature." The term "inquiry" means "examination into facts or principles" and the term "engage" means "to cause someone to become interested or involved in an activity, or to attract someone's interest."

Chapter Summary

Chapter one provides an overview of the study, including the need for the study due to the decline in students' enjoyment and understanding of science from early childhood to middle school. The researcher parallels past experiences in education with

the literature to explain the rationale for the study. This includes realizing, as a middle school science teacher, that students enter middle school disliking science, but realizing as an administrator that students enter kindergarten as "natural-born scientists" who enjoy science. By exploring factors that impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science, the intent is to provide insight into when and how kindergarten teachers engage their students in science to better understand when and why student enjoyment of science fades. This adds to the current literature that supports the need for kindergarten teachers to teach science in a manner that will best build students' understanding of and interest in science. The study goes beyond the current literature by bringing the voices of five kindergarten teachers from two different states into the research.

CHAPTER TWO

LITERATURE REVIEW

Chapter two offers a review of the literature related to teaching science in kindergarten and factors influencing teachers' decisions about when to engage the natural curiosities of their students in science. The chapter begins with the importance of science in the early grades, including the role of children as young scientists. Factors that impact teacher decisions about teaching science are presented. The researcher shares literature pertaining to when teachers engage the natural curiosities of their students in science, and what engagement looks like in the classroom.

The following research question was deconstructed into supporting questions: **What are factors that impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science?** The supporting questions include:

1. What factors impact teacher decisions about when to teach science?
2. Under what conditions do teachers engage students' natural curiosities in science?
3. How do teachers describe engagement in their classrooms?

The research is important because students enjoy science at an early age and learn many skills through science that in turn support success in other subjects in addition to science; however, students' enjoyment of science fades before they reach middle school age. Several factors that impact teaching science appear throughout the literature. They include: teachers' perceptions of student abilities, teacher abilities, lack of materials, and teacher accountability and curriculum factors. Teacher abilities refer to teacher content knowledge (TCK) as well as pedagogical content knowledge (PCK). With regard to accountability and curriculum factors, the research alludes to an emphasis on reading and

math due to testing. Teachers are required to teach reading and math for longer periods of time in an effort to improve students' performance on benchmark and state tests. Because of the curriculum requirements, there is little time to teach science.

Importance of Science in the Early Grades

Science programs are important for developing meaning about science. Early exposure to content and programs influence student competencies, values and conceptions, and attitudes towards science (French, 2004; Patrick, Mantzicopoulos, & Samarapungavan, 2009; Samarapungavan, Mantzicopoulos, & Patrick, 2008). Students need to be able to explore the "functions and structure of scientific language, discourse, and processes" as well as learn concepts and content (Mantzicopoulos, Patrick, & Samarapungavan, 2008, p. 379). Students use the scientific method for "observation, questioning, predicting, experimenting, summarizing, and sharing results." These processes "encourage children's use of language, literacy, and mathematics skills in authentic ways," fostering development in those areas (Gerde, Schachter, & Wasik, 2013, p. 315). Because scientific inquiry skills arise naturally for young students, providing experiences that cultivate STEM (Science, Technology, Engineering, and Math) skills is important (Katz, 2010). Science instruction in the early grades should lay the foundation for learning scientific concepts and scientific thinking (Henrichs & Leseman, 2014).

Children as Scientists

Natural-Born Scientists

Young children enjoy science (Gerde, Schachter, & Wasik, 2013). They are "natural born investigators" according to *A Framework for K-12 Science Education* put out by the National Research Council (NRC, 2012). Children enter kindergarten with

"sophisticated ways of thinking about the world" (NRC, 2007). They have learned about the world by experiencing their physical environment using observation. They experiment with objects falling to the floor, pushing and pulling on things, and observing plants and animals. They talk with others, play, and interact with television. They begin to understand their role in the world and how things work. "Science experiences are already a part of what young children encounter every day through play and interactions with others … teachers and other education providers need to provide a learning environment that encourages children to ask questions, plan investigations, and record and discuss findings" (NSTA, 2014, p. 11)

Helping Children Develop as Scientists

Children's "basic abilities for science learning … can and should be encouraged and supported among children in the earliest years of their lives" according to the *NSTA Position Statement: Early Childhood Science Education* (NSTA, 2014, p. 10). Children's self-concept forms as "science learners and co-researchers in the process of science." They develop an understanding of science as a discipline, and find an interest in science through active engagement (Mantzicopoulos, Patrick, & Samarapungavan, 2008). According to Eshach and Fried (2005), children better understand science concepts as they mature if they have engaged in scientific exploration in their early years. Students develop ideas about the world around them and if they are strictly making observations and exposed to misinformation they will end up with misconceptions about their world. The "uninformed scientific education environment may produce systematic patterns of misconceptions and mismatches that will be resistant to change" (Spektor-Levy, et al., 2013, p. 2247). Examples provided by Harlen (1985) include students believing that

electricity flows better in straight cords and water in pots with lids boils at a lower temperature. Students need to be able to test how it takes force to stop objects, or they will think that it doesn't. It's not just so they better understand that particular concept, but also that they learn to be skeptical of other ideas (Harlen, 1985). According to Harlen (1985), there are two reasons to begin this learning in the early years. First, children start to realize the importance of evidence to support ideas and second, they are more likely to question everyday ideas, which helps cut down on misconceptions. Carrying everyday ideas for a long time makes it harder to change those ideas (Harlen, 1985). Attitudes about science are formed earlier than in other subjects. Children have usually decided by age 11 or 12 whether they like science (Harlen, 1985). Children "develop an independent attitude toward science," and according to the literature there is a "significant decline in positive attitudes towards science and achievements in science, especially in the middle and high school" (Spektor-Levy, et al., 2014, p. 2230). Because learning science has the ability to support children's development in other domains in meaningful ways, teachers should feel "empowered to engage in science" (Gerde, Schachter, & Wasik, 2013, p. 317).

Factors That Impact Teachers' Decisions about Teaching Science

Practice in the classroom is influenced by beliefs and knowledge acquired in the classroom informs beliefs (Veal, 2004). Pedagogical Content Knowledge (PCK) "emphasizes a teacher's beliefs regarding the goals of science teaching and the instructional strategies that correspond to that particular orientation" (Fuentes, Bloom, & Peace, 2014, p. 31).

According to Henrichs and Leseman (2014, p. 2992), “It appears worthwhile to offer a positive stimulus to teacher attitudes regarding science by explaining and emphasizing the importance of early science experiences for young children, and to point out possibilities to integrate language instruction in such experiences.” The manner in which science is taught in the early grades is not effective. Early childhood teachers’ knowledge of science and pedagogy needs to improve (Sackes, et al., 2011). Teachers need to deepen content knowledge and pedagogy, as opposed to relying on remembering facts and terms, and knowing procedures (Fuentes, Bloom, & Peace, 2014). There are many factors that contribute to a teacher’s science teaching identity. Teachers have varying degrees of exposure to science, knowledge of science, and understanding of its processes. Teacher content knowledge (TCK) is inadequate due to a lack of science courses taken during educational training (Sackes, 2012). Teachers do not feel prepared to teach science to students in their classrooms (Fulp, 2002). In *More Than a Read-Aloud: Preparing and Inspiring Early Childhood Teachers to Develop Our Future Scientists*, researchers found that when rural early childhood teachers participated in a hands-on workshop on integrating science with language arts, their self-efficacy about teaching science improved (Atiles, Jones, & Anderson, 2013, p. 295). In one study, researchers found that teachers were not willing to engage in additional schooling because they were too busy (Henrichs & Leseman, 2014). “Due to a number of factors, including educators’ low self-efficacy for teaching science and lack of educational resources, many early childhood classrooms do not offer high-quality science experiences for young children” (Gerde, Schachter, & Wasik, 2013, p. 315).

Materials

Materials impact teachers' willingness to teach science. Teachers who have access to manipulatives and nature areas are more motivated to teach science, but may not always utilize materials effectively (Sackes, 2012). According to Henrichs and Leseman (2014), "science-related materials can only be an affordance for practicing academic language when teachers can draw upon sufficient content knowledge" (p. 2992). Many schools spend a significant amount of money on science materials, but not on professional development regarding how to use the materials effectively (Nelson & Landel, 2007).

Teacher Perceptions of Children's Abilities

Ginsburg and Golbeck (2004) say we need to investigate what teachers understand about the nature of students' learning and thinking. Also, it would be useful to know how teachers' own feelings about science influence how they present these topics (Ginsburg & Golbeck, 2004). "Many adults, including educators, tend to underestimate children's capacity to learn science core ideas and practices in the early years and fail to provide the opportunities and experiences for them to foster science skills and build conceptual understanding" (NRC, 2007, p. vii).

Time for Tested Subjects

Less time is spent teaching science because math and literacy are assessed using standardized tests as mandated by No Child Left Behind (Griffith & Scharmann, 2008). According to Honey (2011), math and language arts are taught most of the day, leaving no time for science and other subjects. Before enactment of No Child Left Behind,

science was taught more frequently in primary grades; however, teachers felt there was not enough time for teaching science, even then (Griffith & Scharmann, 2008).

When Do Teachers Engage Students' Natural Curiosities in Science?

Patrick et al. (2009) state that teachers should integrate reading and writing about science topics with inquiry activities. This approach "establishes a cohesive context in which children can develop skills and knowledge important for both literacy and science" (Patrick, Mantzicopoulou, & Samarapungavan, 2009, p. 38).

Reasons vary, but teachers do not provide "high-quality" experiences for science in early childhood (Nayfeld, et al., 2011). Rather, they teach using experiments in isolation instead of making connection to other parts of the curriculum (Nayfeld, et al., 2011). Often science instruction is presented superficially, engaging students in part of the scientific process (Brenneman, et al., 2009). Science plays only a minor role in the kindergarten curriculum (Henrichs & Leseman, 2014). According to Sackes, Trundle, Bell, and O'Connell (2011), science is only taught up to 60 minutes in a week. Sackes (2012) attributes teacher lack of content knowledge as a factor, as well as availability of materials for teaching science, and teachers' perceptions regarding children's abilities to learn the material.

Sackes found that "teachers' perceptions of control over the curriculum did not influence how often early childhood teachers teach science." Teachers who have control over their curriculum are "no more likely to teach science than other teachers" (Sackes, 2012, p. 181).

Integrating Science and Reading

There is a big push to teach science through reading, but it is difficult to do so because teachers are more prepared and therefore more comfortable with language arts; therefore they primarily teach reading and sprinkle in a little science content (Mantzicopoulos, Patrick, & Samarapungavan 2008; 2009).

When it comes to teaching science, early childhood teachers are more comfortable with life science. It's possible that teachers are less comfortable with physical and earth science due to the lack of literature that could be used in the kindergarten classroom to teach these concepts (Sackes, 2012). This is addressed in *Using Children's Literature to Teach Standard-Based Science Concepts in Early Years*. The authors say that it is difficult to find children's books that focus on physical and earth science concepts (Sackes, Trundle, & Flevares, 2009). It could be that early childhood educators demand more life science books, or early childhood teachers could be more comfortable teaching life science because more such books are available (Sackes, Trundle, & Flevares, 2009). "Lack of experiences with informational picture books in the early grades may curtail children's later interest in, engagement with, and comprehension of these texts in content areas such as science (Mantzicopoulos & Patrick, 2010, p. 270).

What Does Student Engagement Look Like?

"[The] most influential factor in the children's learning experiences is the educational professional who sits by their side and tutors them in the required contents and skills" (Spektor, et al., 2013, p. 2228). The way the teacher behaves impacts a student's disposition for exploration (Engel & Labella, 2011). Effective science teaching in kindergarten means providing planned inquiry opportunities where children make

predictions and observations, and answer questions using materials that are developmentally appropriate (Sackes, et al., 2011).

The NRC Framework (2012) suggests that teachers help students build on conceptions by guiding them in their understanding of increasingly sophisticated explanations for phenomenon. We should no longer give simple descriptions in early grades and explanations only in higher grades (NRC, 2012).

"Effective science investigations can deeply engage young children for extended periods of time, beyond a single activity or session" (NSTA, 2014, p. 10). Educators should monitor signs from students and adjust teaching to support their curiosity, understanding and learning (NSTA, 2014, p. 11). "Young children engage in science activities when an adult intentionally prepares the environment and the experiences to allow children to fully engage with materials. The activities allow children to question, explore, investigate, make meaning, and construct explanations and organize knowledge by manipulating materials" (NSTA, 2014, p. 11). The scientific method should be used to explore science with young students to provide a "systematic model for engaging children in observation, questioning, predicting, experimenting, summarizing, and sharing results," according to Gerde, Schachter, and Wasik (2013, p. 315).

Curiosity

"Curiosity is operationally difficult to investigate—it is unobservable directly as it requires the use of inference indicators, it is not a unitary construct and is dynamically changing" (Spektor-Levy, et al., 2013, p. 2232). In a recent study teachers noted that curious children have a need to "share with their surrounding[s], but did not emphasize their role in facilitating this process, [which] might indicate a gap between the teachers'

perceptions and intentions to act" (Spektor-Levy, et al., 2013, p. 2247). Engel (2011) says "When children are curious, they learn" and "curiosity in school is not merely a nicety but a necessity" (p. 628). Educators can foster scientific curiosity by being attentive, modeling excitement, questioning, getting students' attention, facilitating inquiry, using stories and games, providing stimuli, and using multisensory methods of teaching (Spektor-Levy, 2013).

CHAPTER THREE

METHODOLOGY

This chapter presents the research design and methods, including the research question, research design, site selections, co-researcher selections, data collection, and data analysis.

Research Question

The overarching research question that establishes the study is: What are factors that impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science? In order to address the overarching research question, three questions emerged and they are: 1. What factors impact teacher decisions about when to teach science? 2. Under what conditions do teachers engage students' natural curiosities in science? 3. How do teachers describe engagement in their classrooms?

The purpose of the study is to gain insight into teachers' thinking as they decide when and how to engage their students in science, to better understand why student enjoyment of science fades in early grades; to contribute teachers' voices to the existing literature on teaching science in the early grades; and to investigate how teachers' science teaching methods align with current research regarding how students learn best.

According to the National Science Teachers Association, "inquiry science must be a basic in the daily curriculum of every elementary school student at every grade level" (NSTA, 2002). The literature reveals that young children learn best when they are "involved in first-hand exploration and investigation and inquiry/process skills are nurtured" (NSTA, 2002). Results from the study will provide a basis for designing and

testing various interventions to help teachers improve their practices in the classroom around engaging students' natural curiosities to improve academic learning.

Research Design

This was a participatory action research study that used autoethnography, case studies, and grounded theory methods. The study was undertaken to gain insight from kindergarten teachers about factors that influence their decisions about when to engage their students' natural curiosities in science. It involved a participatory action research approach grounded in data from co-researchers experiencing the process, and narrative inquiry using interviews. See Table 1. "Often the answer to why people do what they do is found not just within the individual but, rather, within the systems of which they are a part; social, family, organizational, community, religious, political, and economic systems" (Patton, 2015, p. 8). Although the researcher attempted to understand each individual case, a general description of when and how kindergarten teachers teach science was also explored through cross-case analysis. Qualitative research is personal (Patton, 2015, p. 3). Therefore, this study includes autoethnographical data (Hughes, Pennington, & Makris, 2012) in that the researcher took "an active, scientific, and systematic view of personal experience" in relation to the kindergarten community (p. 209).

Table 1. Overview of Research Design

Overarching Research Question	What are factors that impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science?
Methods	Participatory action research, autoethnography, case studies, grounded theory
Sources of Data	Initial and culminating interviews; journal entries by researcher and co-researchers
Research Questions	1. What factors impact teacher decisions about teaching science?
	2. When do teachers engage students' natural curiosities?
	3. What does engagement look like?

Note: The table presents the research design, including the research questions, methods, and sources of data.

Table 2 below presents information about the data collected to answer each research question. For all three questions, the researcher used individual interviews and In Vivo coding to identify emergent themes from patterns (Saldana, 2009). For research questions one and two journal entries were collected using a journal checklist that was developed by the researcher with input from co-researchers. When analyzing journal entries data frequency counts were used. The answers to question number three regarding teachers' descriptions of engagement came from initial and culminating interviews.

Table 2. Types and Methods of Data Collected with Analysis Strategies

Overarching Research Question: What factors impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science?			
Research Questions:	Data Collected	Method	Analysis Strategies
1. What factors impact teacher decisions about when to teach science?	Initial interviews	Individual (Narrative)	In Vivo Patterned coding
	Journal entries	Journal Checklist	Frequency Counts
	Culminating interviews	Individual (Narrative)	In Vivo Patterned coding
2. Under what conditions do teachers engage students' natural curiosities in science?	Initial interviews	Individual (Narrative)	In Vivo Patterned coding
	Journal entries	Journal Checklist	Frequency Counts
	Culminating interview	Individual (Narrative)	In Vivo Patterned coding
3. How do teachers describe engagement in their classrooms?	Initial interviews	Individual (Narrative)	In Vivo Patterned coding
	Culminating interviews	Individual (Narrative)	In Vivo Patterned coding

Note: The table presents the data collected to answer each research question, including the method for collection and analysis strategies.

Purposeful sampling was used to select a range of kindergarten teachers in Tennessee and Alabama with different perspectives on teaching science; some from county systems and some from city systems; some using Alabama Math, Science, and Technology Initiative (AMSTI) kits and some not using kits, to strive for triangulation.

Site Selection

Alabama and Tennessee were selected as research sites because the researcher's previous career experiences as a middle school science teacher and then an administrator of an elementary school in Tennessee sparked interest in the study. The researcher wondered why students entered middle school hating science, noticed that science was

not being taught in kindergarten, and wondered if a connection existed. The researcher's present experiences working in Alabama gives a contrasting view of how early childhood teachers could teach science after being trained in the use of AMSTI science kits. AMSTI is an initiative by the Alabama Department of Education to improve math and science learning across the state. They provide professional development, equipment and materials, and on-site support to those who are part of official AMSTI schools. Teachers and administrators attend two-week institutes for two summers to become an AMSTI school. For the study the researcher sought both AMSTI schools and non-AMSTI schools in Alabama. See Appendix B for more information on AMSTI projects.

Co-Researcher Selection

Five teachers in four school systems in the Tennessee/Alabama region were purposefully selected based on a range of experiences. They included one teacher from a county system and one from a city system in Tennessee, and one teacher from a county system and two from a city system in Alabama. Each system had one kindergarten teacher participating as a co-researcher, with the exception of the Alabama city system, which had two teachers participating. The Alabama city system has four elementary schools, and the two co-researchers from this system were from different schools. The number of years teaching for all five teachers ranges from five to twenty-six years. All teachers were given pseudonyms to protect their identities.

Table 3. Information about Co-Researchers

Teacher	Pseudonym	School System Type	Years
2*	Angie, Sawyer	Alabama City System	12, 6
1	Virginia	Alabama County System	26
1	Carmen	Tennessee City System	15
1	Kirby	Tennessee County System	5

Note: The number of co-researchers from the different school systems in Alabama and Tennessee, pseudonyms of the co-researchers, and the number of years' teaching experience. *These two teachers, Angie and Sawyer, are from different schools.

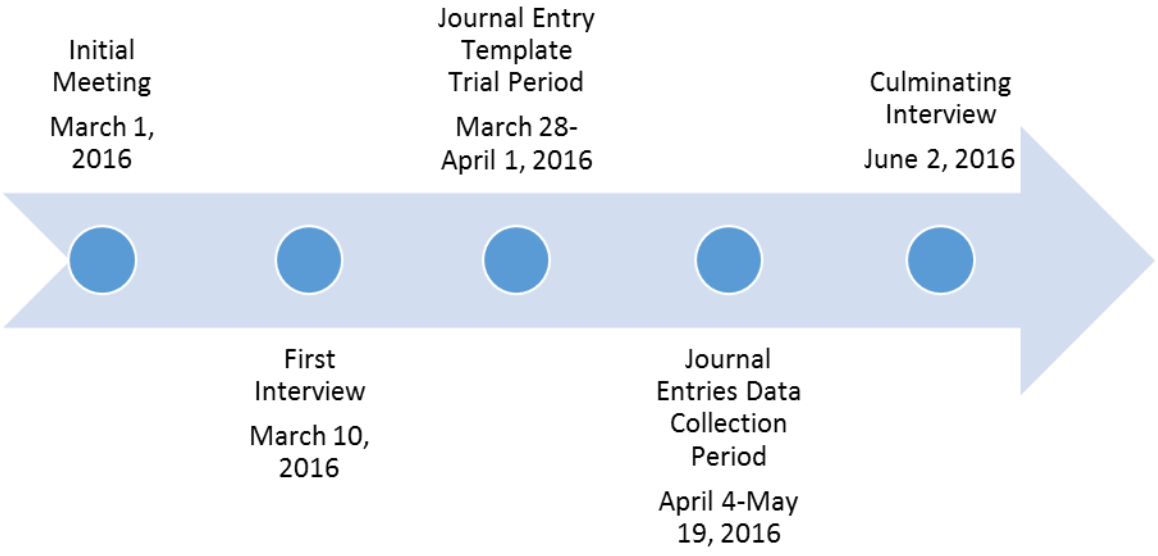
Initial screenings for co-researchers included reaching out to central office personnel in two school systems in Alabama. One county system sent a mass email to kindergarten teachers. Virginia was the only teacher who responded with interest in the study. After a few email exchanges and a classroom visit to explain the study, Virginia was selected to participate as a co-researcher and the initial interview was set up. In contrast, the superintendent of the Alabama city system required kindergarten teachers to meet with the researcher. The researcher arranged to meet with them in groups instead of individually, and the study was explained. After visiting three schools with four to five teachers per school, two teachers from different schools were selected to act as co-researchers in the study.

Permission to approach teachers about the study was obtained from two school systems in Tennessee. Central office personnel in one system sent a mass email to all kindergarten teachers. In the other school system central office personnel granted permission for the researcher to approach kindergarten teachers about the study. Co-

researchers were not identified from these two systems. The researcher approached school system liaisons from two different school systems in Tennessee with descriptions of what was needed for the study. One was a county school system and the other was a city school system. The liaisons were able to secure co-researchers who met the researcher's criteria. A brief introduction and timeline of participation for each co-researcher follows.

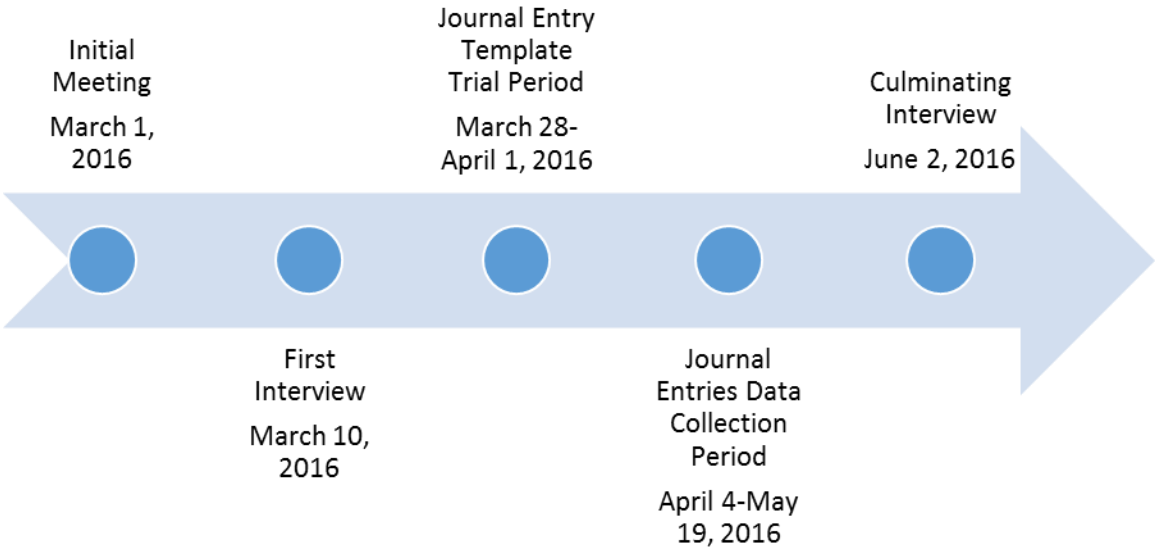
Angie

Angie, a teacher from the Alabama city system, has taught kindergarten for twelve years. She "comes from a family of educators." Her mother was a librarian and her father a middle school teacher. Angie declared early on that she was not going to be a teacher. After taking some courses in law, she decided that education was more appealing, but made another declaration that she was never going to teach kindergarten. While completing her student teaching in kindergarten Angie fell in love with kindergarten. She acquired a job at the same school where she completed her student teaching and has been teaching kindergarten at the school ever since. The timeline for Angie's participation in the study is presented below.



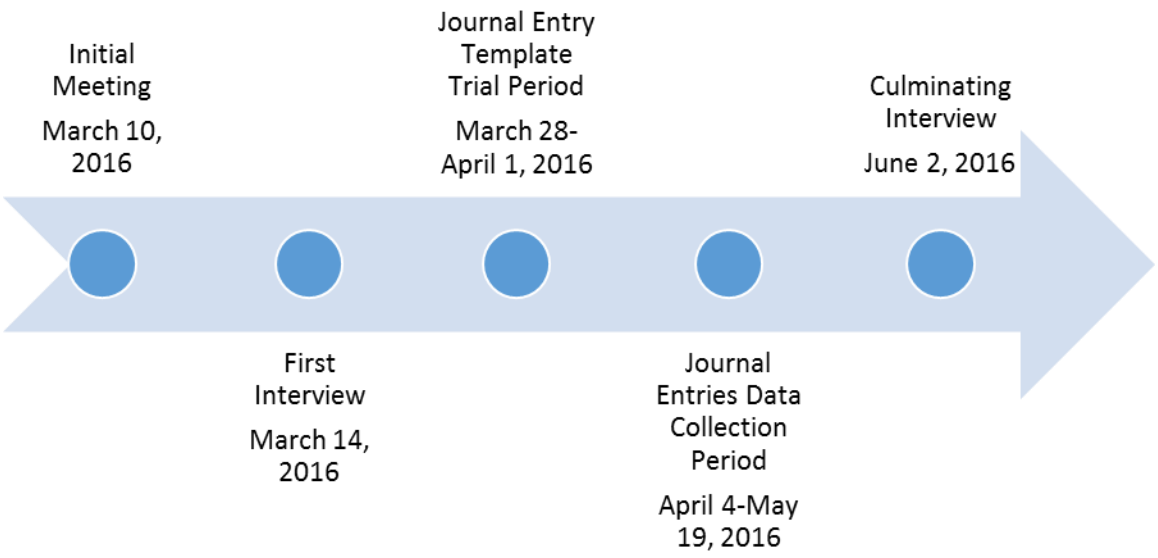
Sawyer

Sawyer, a second teacher from the Alabama city system (but from a different school) has been teaching for six years. She knew in high school, after babysitting, that she wanted to be in a profession where she could work with children. Teaching was a "natural fit" for her. The timeline for Sawyer's participation in the study is presented below.



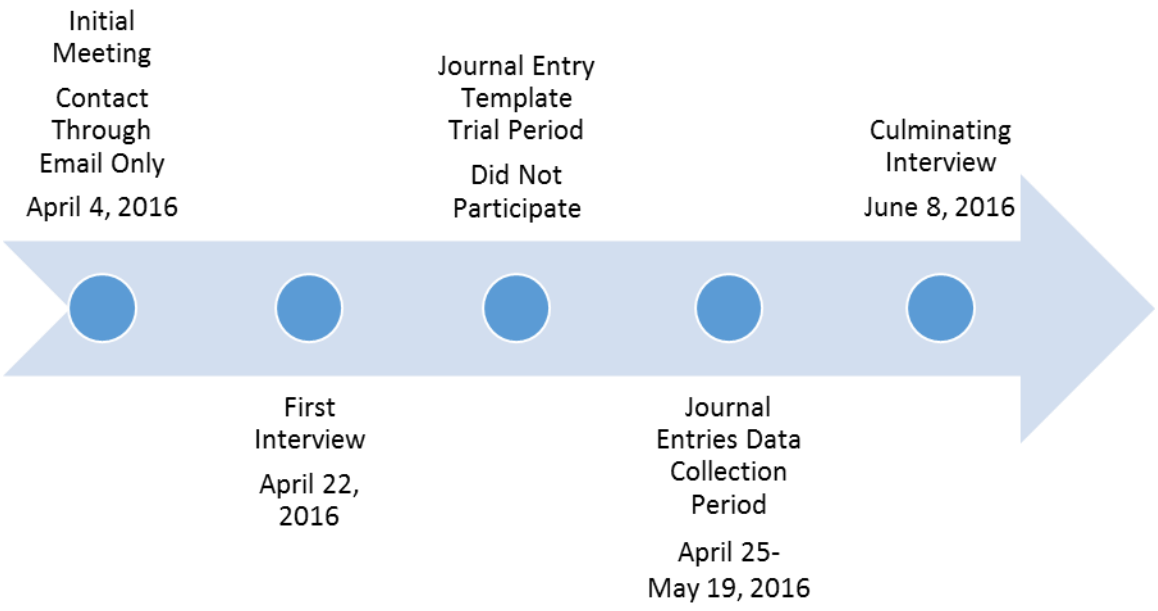
Virginia

Virginia, a teacher from the county system in Alabama, has been teaching for twenty-six years. When she was growing up everyone told her she was going to be a teacher. In college she couldn't decide what she wanted to do, but after working in a daycare center for a year, Virginia decided that teaching was what she needed to be doing with her life. The timeline for Virginia's participation in the study is presented below.



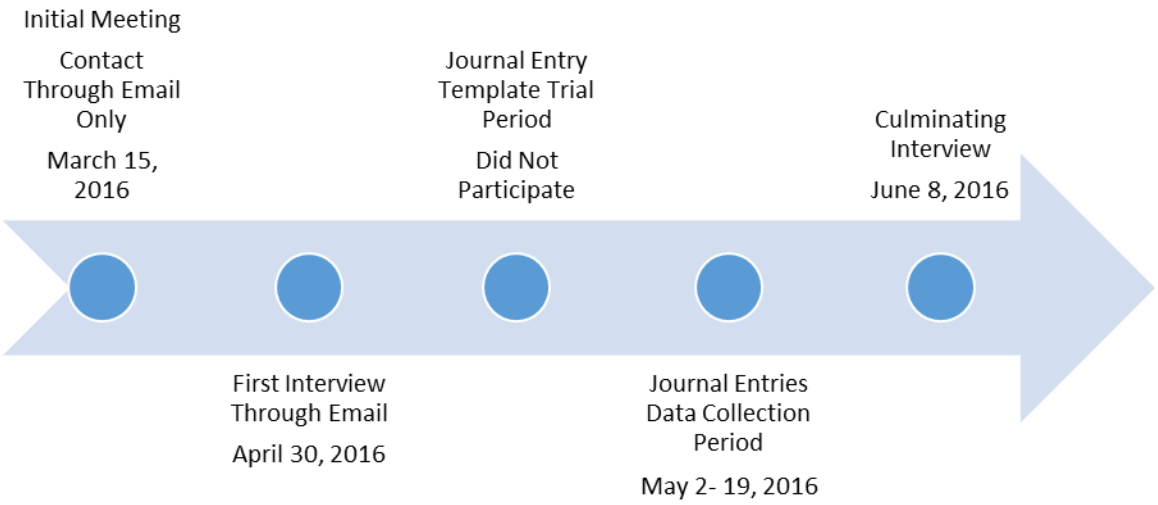
Kirby

Kirby, a teacher from the county system in Tennessee, has been teaching for five years. After ten years as a social worker, she decided that social work was not where she wanted to be. She still had a desire to work with children, and teaching gives her that opportunity. Kirby admitted that in teaching she has to deal with some sensitive issues, but nothing like what she did as a social worker. The timeline for Kirby's participation in the study is presented below.



Carmen

Carmen, a teacher from the city system in Tennessee, has been in education for fifteen years. As a child she often visited her aunt's classroom and enjoyed being there, but in college she pursued nursing. After accompanying her mother, a nurse, to care for an elderly neighbor, Carmen decided nursing was not the profession for her. The timeline for Carmen's participation in the study is presented below.



Initial Meetings

Initial meetings occurred in a variety of formats. In the Alabama county system the central office sent an email to kindergarten teachers and one teacher responded with interest. The initial meeting with this co-researcher, Virginia, took place in her classroom. In the Alabama city system, meetings were arranged through central office and took place with groups of kindergarten teachers at individual schools. These

meetings took place in conference rooms at the schools. The meetings resulted in selection of two teachers from different schools to participate in the study. In Tennessee both co-researchers were identified through two different school district liaisons after working with two other school systems in which no co-researchers were identified. Meetings with individual teachers and groups in Alabama lasted about 15 minutes and provided details about the study. There were no face-to-face initial meetings with the Tennessee teachers; information sharing took place via email. The initial meetings in Alabama were not recorded; however, notes were taken and the researcher wrote about the meetings in a journal afterwards.

First Interviews

The researcher selected interview sites through discussions with co-researchers, so they would be comfortable, listened intently for meaning during interviews, and afterwards noted interviewees' proximity, gestures, body language, and tone during the interview (Patton, 2015; Brinkmann & Kvale, 2015). First interviews for three co-researchers were conducted in classrooms or school meeting rooms. One first interview took place at a Subway restaurant. All but one (with the co-researcher teaching the furthest away) were face-to-face meetings. After three attempts to meet in person and one attempt at a phone interview, the interview questions were emailed to the co-researcher, who responded and emailed them back to the researcher. Answers were coded the same way as answers to in-person questions after they were transcribed by the researcher. Transcriptions were completed by the researcher and sent to co-researchers for clarifications, additions, and deletion of content. Questions for the first interview (with study research question in square brackets) included:

1. How many years have you been in education [background information]?
2. How did you decide to become a teacher [background information]?
3. What does student engagement look like in your classroom [two and three]?
4. How much time do you spend weekly teaching science [one]?
5. How does this compare to the time recommended/required by your school system [one]?
6. What factors contribute to the amount of time spent teaching science (be as specific as possible) [one]?
7. How do you decide what to teach in science [two]?
8. How do you decide the method of delivery for the content [two]?
9. When are times you have integrated science with other subjects [two]?
10. What else would you like to share about teaching science in your classroom?

Questions for initial interviews were created after reading through the literature and consideration of the research questions. The first two questions were chosen to gain more information about the co-researchers' teaching history. Question three was selected to address research questions two and three regarding students' engagement and natural curiosities. Questions four, five, and six were chosen to address research question one regarding the factors that impact teacher decisions about when to teach science. Questions seven, eight, and nine were selected to address the second research question about conditions in which teachers engage students' natural curiosities in science. The last question was used to give co-researchers an opportunity to share anything they wanted the researcher to know that did not come up in earlier questions, as described by Patton (2015).

During interviews the researcher paid attention to both obvious and not-so-obvious signals, including body language and tone. The researcher noted proximity of interviewee, asked for elaboration in interviews, asked for input on the journal template, and paid close attention when co-researchers spoke (Patton, 2015; Brinkmann & Kvale, 2015). After initial interviews, transcriptions were sent to co-researchers for clarifications, additions, and deletion of information.

Journal Entries Data Collection

Once the initial round of interviews in Alabama was complete, a journal template was created by the researcher and sent to co-researchers for a one-week trial run and feedback. Data collected for the template is presented in the table below and is described in detail in the following paragraphs. See Table 4. A copy of the actual template can be seen in Appendix E.

The first question asked co-researchers whether science had been taught that day. If the answer was yes, the next question asked whether it was integrated with another subject or taught as an independent lesson. If it was integrated, the next question asked co-researchers whether the lesson was integrated with reading, math, or another subject. The next question on the template asked co-researchers whether the lesson was spontaneous and, if so, whether it was teacher or student initiated, or whether the lesson was planned. Other questions on the survey included whether or not the lesson was standards-based and whether or not the lesson was part of a kit. The co-researcher was also asked to rate the topic of the lesson on a scale of 1 to 10 as their favorite (10) or least favorite (1) to teach. Although pedagogical content knowledge and teacher content knowledge never surfaced as an issue in the initial interviews, the researcher wanted to

gather data with the potential to reveal PCK/TCK during culminating interviews. For example, if a co-researcher reported teaching a least favorite topic, the researcher probed during questioning about the co-researcher's comfort level with content and ability to teach the topic.

If science was not taught that day, co-researchers were to skip all portions of the journal mentioned in the paragraph above and instructed to answer a later question that asked them to select the factors that impacted the decision not to teach science. They had to indicate whether there was an assembly (including pep rallies, awards ceremonies, and club meetings); testing, and in which subject; whether more time was needed for reading, math, or another subject; whether students needed a longer nap time (only for Alabama city teachers because nap time surfaced as an issue during the initial interviews); and whether resources were available. Options to include on the journal entries template were selected using information from initial interviews and the literature. For example, the literature referenced integrating science with reading, needing more time to teach reading and math, testing, and limited resources. In addition, co-researchers discussed these topics during initial interviews. The co-researchers from Alabama also mentioned using kits, so the researcher spent some time researching AMSTI (Alabama Math, Science, and Technology Initiative), and using kits was an option added to the template. More information about AMSTI is presented in Appendix B. The literature revealed pedagogical content knowledge and teacher content knowledge as factors to consider with regard to when and why teachers teach science. These factors never came up in initial interviews with co-researchers, but the researcher wanted to collect data that might reveal a lack of PCK/TCK during culminating interviews. If a co-researcher had logged

teaching science topics that were their least favorite to teach, the researcher would have probed with further questioning to reveal the co-researcher's comfort level with content knowledge and teaching ability for that topic or topics. The researcher also acquired the idea for spontaneous instruction during the literature review when researching natural curiosities. Asking whether the lesson was planned or spontaneous and who initiated it was added to the template. The options of standards, assemblies/school functions, and nap time were discussed during initial interviews with co-researchers, and were also added to the template.

Table 4. Daily Decisions Made about Science Instruction as Recorded in Journal Entries

Science was taught today	Option 1	Sub-option	Option 2
Yes	Integrated	Reading	Independent
		Math	
		Social studies	
		Other	
	Spontaneous	Teacher	Planned
		Student	
	Standard		Not a Standard
	Topic	Feelings (1-10)	
	Kit		Not a Kit
No	Assembly		
	Testing	Reading	
		Math	
		Other	
	More Time	Reading	
		Math	
		Other	
	Longer Nap		
	No Resources	Items Needed	

Note: Table presents available options for recording in journals decisions about teaching science.

There was a one week trial period before collecting data. Co-researchers printed hard copies of the template to record their journal entries. They emailed the researcher

with their thoughts and recommendations on the template at the end of the week. The co-researchers unanimously felt that the template met the goals of the study. Their only suggestion after the trial period was to add a daily comments section instead of a weekly comments section that could be used for any additional information they wanted to share. (For example, co-researchers used the comments section to report that students wrote Mother's Day thank you letters instead of experiencing science.) The comments section was added to the template by the researcher. The template was created in an online survey software application called Qualtrics that generated links for co-researchers. One link was generated for Alabama co-researchers and a separate link for Tennessee co-researchers. The templates were identical. Separate links were used in case the researcher decided later to compare data from the two states; however, this was not done because of the differences in journal data collection times. The links were emailed to the respective co-researchers and data collection began.

After the trial run, Alabama teachers began collecting data on April 4, 2016. In Tennessee, Kirby began collecting data on April 25, 2016 and Carmen began on May 2, 2016, as seen in Table 5.

Table 5. Journal Data Collection Time Frames

Dates	Angie	Sawyer	Virginia	Kirby	Carmen
March 28-April 1, 2016	Journal Data Collection Trial Period				
April 4-8, 2016	Journal Data Collection				
April 11-15, 2016					
April 18-22, 2016					
April 25-29, 2016				Journal Data	
May 2-6,2016					Journal Data
May 9-13,2016					
May 16-19,2016					

Note: Table presents timeframes for journal data collection.

The goal of the journal entries was for co-researchers to record their daily science activities and their decisions regarding consideration and implementation of such activities. Co-researchers were to log entries daily. The specific dates on which co-researchers logged or did not log data can be found in Table 25.

Culminating Interviews

After data collection through journals ceased, a culminating interview took place with each co-researcher. Although the structure of the interview was similar to the initial interview, culminating interview questions were different. Both lists of questions are presented in Appendices D and F for easy comparison. Whereas initial interview questions were more about what generally happens in the co-researcher's classroom, culminating interview questions focused on what actually happened during the data collection time period. The interview structures were similar in that co-researchers had input about location of interviews, permission was obtained to record the interviews, and the interviews were conversation-like. Culminating interview questions (with study research questions in square brackets) included:

1. In reflecting on your journal entries, what did you notice [general question to get their perspective]?
2. What did you take into consideration when planning science activities [one]?
3. In what ways did your science activities go as planned [two]?
4. In what ways did your science activities not go as planned [two]?
5. How were the levels of engagement during science activities [three]?
6. What were some of the factors that impacted your decisions on when to engage your students in science [one]?

7. How has your participation in this study impacted your science instruction [general question to get their perspective]?

The first question for culminating interviews was intended to reveal what, after reviewing their journal entries data, stood out most to co-researchers. Questions number two and six were asked to gather information to answer research question one regarding factors that impact teacher decisions about when to teach science, and research question two regarding conditions in which teachers engage students' natural curiosities. In addition questions three and four sought to gather more information about research question two, as the researcher was curious about spontaneous instruction, besides other items. Question five was asked to gather insight into research question number three in which co-researchers describe engagement in their classrooms. The final question inquired whether co-researchers were impacted by the study and, if so, in what manner.

The two Alabama city teachers were interviewed at a Starbucks cafe, with Sawyer's in the morning and Angie's in the afternoon on the same day. The Alabama county teacher, Virginia, was interviewed at a local business while she performed cheerleader coaching duties. The two Tennessee teachers, Kirby and Carmen, were interviewed the following week at a Subway restaurant in Tennessee, one immediately following the other.

The researcher's experiences as a former science teacher and assistant principal in a primary school could have shaped the interpretation of data collected. Although some contamination can be expected because there is no way to eliminate it, the researcher was determined to minimize it by journaling and then designing steps to decrease it. Steps included but were not limited to: using multiple types of data for data source triangulation

(interviews, teacher journaling, researcher journaling), and selecting co-researchers with alternative viewpoints for theory triangulation (Denzin, 1989). Co-researchers were from county and city systems in two states and ranged in teaching experience from five to twenty-six years. The researcher kept an open mind during interviews and sought multiple views in the literature regarding the research question, striving for triangulation (Stake, 1995). The primary goal was to understand the views and perspectives of others—in this case each kindergarten teacher—including how they feel about factors that impact their decisions about teaching science, while remaining mindful of honoring individual values (Creswell, 2013). After the culminating interviews, transcriptions were sent to co-researchers for clarifications, additions, and deletion of information, as after the initial interviews.

The Autoethnographic Contribution: The Researcher as Co-Researcher

To begin, three schools in the Alabama city system were visited and resulted in selection of two teachers to be co-researchers. One Alabama county system teacher joined the study as co-researcher after replying to an email requesting participants. A Tennessee county teacher and a Tennessee city teacher were both recruited through school system liaisons. The goal was to seek a total of four to six individuals interested in participating as co-researchers in the study. Informal data collection began before the co-researchers' commitment to do the study, as the researcher observed each co-researcher's actions and behaviors, either in person or via email, to get a feel for their level of interest in the study and how they would impact the study with their experiences. Stake (1995) states that the "pool of data includes the earliest of observations" (p. 49). During initial meetings, in both cases in which the co-researchers were identified from a

group of teachers, the co-researchers asked most of the questions, answered most of the researcher's questions, and sat in close proximity to the researcher. They appeared to take the lead role as far as setting up the meeting space and demonstrating a positive attitude about the required meeting. These co-researchers shared that they knew someone who had recently completed a doctoral dissertation and were happy to help with the researcher's study.

During the course of the study, the researcher viewed the researcher's role as that of a traveler, conversing with people encountered, asking questions to find out about their stories (Brinkmann & Kvale, 2015). According to Brinkman and Kvale (2015), the traveler interprets the new knowledge, possibly changing their current thinking (p. 57). The researcher was also mindful of the interview position held during the process as described by Brinkman and Kvale (2015), which in this study was that of a participant (p. 109). The intent during the interview was to create an environment that permitted the interviewee's point of view to "flourish" (Brinkmann & Kvale 2015, p. 154), and the researcher practiced being an active listener during the interviews (Brinkmann & Kvale 2015, p. 164-165).

Although the researcher intended to seek individuals with varying backgrounds and beliefs, no specific "type" of co-researcher was sought. Instead, the researcher looked for a range of kindergarten teachers with varying backgrounds and voices to contribute to the research. Once the co-researchers were identified, three from Alabama and two from Tennessee, commitments were secured prior to more in-depth individual first interviews. The researcher secured informed consent forms for participation in the

study prior to the first interview. The researcher also received verbal consent to record the conversation prior to each interview.

During first interviews, the researcher recorded each session with multiple devices including a voice recorder, a tablet, and a cell phone. The researcher then transcribed using In Vivo coding. Pattern coding was used to identify emergent themes (Saldana, 2009) as discussed in the Coding Manual for Qualitative Researchers. See Table 6 for initial interview coding and Table 7 for culminating interview coding. Discussion regarding findings can be found in chapter five.

Co-researchers were assured anonymity to the best of the researcher's ability, and interview recordings were deleted from devices once transcribed, after approval of transcriptions by interviewees. A transcript was sent to each interviewee for verification and/or clarification of facts. Interviewees were invited to make affirmations, revisions, and/or deletions, but none were made.

Table 6. Coding for Initial Interviews

Initial Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Family of Educators				Aunt was a Teacher	2	Family
Aspired to be a Lawyer	Undecided Babysitter in High School	Undecided Worked in a Daycare After Graduation	Worked as a Social Worker for 10 years	Aspired to be a Nurse	5	No early aspirations to be a teacher
Music Moving Videos Excitement	 Attention Echo Responses	Music Videos Manipulatives	Music Moving Videos Excitement Participation	 Moving Excitement Manipulatives Attention Participation	3 3 3 3 2 2 2 1	Participating in/paying attention shows engagement

Initial Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Books	Focused				1 1	
60 minutes (if lucky)	150 minutes (best case scenario)	120 minutes (maybe, that might be pushing the envelope)	Not allotted in schedule	125 minutes (varies by week)	Times vary	Times for teaching science varies, but it is difficult to get science into the schedule
			Used to be every other week	Every other week	2	
Makes choice between subjects due to lack of time					1	
Integrates			Integrates		2	No time requirement by school system
No requirement by system	No requirement by system	No requirement by system	No requirement by system	No requirement by system	5	

Table 6. (continued)

Initial Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Factors that impact teaching science include the schedule and time	Factors that impact teaching science include the schedule and time programs	Factors that impact teaching science include Focus is on reading and math testing	Factors that impact teaching science include Science is part of calendar time testing	Factors that impact teaching science include time programs	2 3 2 1 1 2	Schedules, time, programs, and testing are factors that impact teaching science
Conditions in which teachers engage students in science AMSTI kits STEM kits Standards Integration Videos	Conditions in which teachers engage students in science AMSTI kits Seasons	Conditions in which teachers engage students in science Standards	Conditions in which teachers engage students in science Seasons Letters	Conditions in which teachers engage students in science Standards Seasons	2 1 3 1 1 3 1	There is a variety of considerations when deciding to engage students in science, including using kits, teaching standards, and seasons.
Method of delivery decided on Enjoyment Fun Involvement	Method of delivery decided on Class make-up	Method of delivery decided on Hands-on Thematic units	Method of delivery decided on Stories Writing	Method of delivery decided on Hands-on Video Time	1 1 3 1 1 1 1 1	There is a variety of delivery methods, but teachers want to do hands-on

Table 6. (continued)

Initial Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Science is integrated with Reading Math	Science is integrated with Reading Math Holidays	Science is integrated with Thematic unit	Science is integrated with Reading	Science is integrated with Reading	4 2 1 1	Science is mostly integrated with reading
Share about teaching science Integrate everything	Share about teaching science Let them create	Share about teaching science AMSTI training this summer	Share about teaching science Wish for more time	Share about teaching science Good intentions fell short	1 1 1 1 1	Each co-researcher had something different they wanted to share about teaching science in their classrooms

Note: Table presents coding for initial interviews. Discussion of findings can be found in chapter five.

Table 7. Coding for Culminating Interviews

Culminating Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Noticed about journal entry data Lessons revolved around kits and the standards	Noticed about journal entry data Taught more often than thought and mostly independent lessons	Noticed about journal entry data Did not teach science as much as she thought	Noticed about journal entry data Had to fit science in somewhere else and didn't cover all the standards	Noticed about journal entry data Have to do science first thing in the morning in order to get it in	1 1 1 1 1 1 1	Each co-researcher noticed something different about their data.
When planning science activities Time Resources Change for K	When planning science activities Hands-on	When planning science activities Reading	When planning science activities Reading activity	When planning science activities Attention span Stimulation	1 1 1 1 2 2	Variety of things here; some co-researchers thought about what science activities would go with reading and some thought about hands-on experiences

Culminating Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Science went as planned All as expected	Science went as planned Taught lessons before	Science went as planned Did not do a lot of activities	Science went as planned Questions related to stories	Science went as planned Mostly, but veered off in a good way	1 1 1 1 1	Most felt science activities went as they had planned "Veered off" went into discussion about spontaneous interactions
Science did not go as planned Simple task was difficult (tearing tape)	Science did not go as planned Needed more time	Science did not go as planned School functions	Science did not go as planned All worked	Science did not go as planned Testing	1 1 1 1 1	There were several different reasons for a science activity to not go as planned
Levels of student engagement were Very engaged	Levels of student engagement were Very high	Levels of student engagement were Pretty good	Levels of student engagement were Very engaged with hands-on	Levels of student engagement were Good	3 2	Engagement was good during science lessons, appeared highest during hands-on activities
Factors impacting decisions on when to engage in science AMSTI kits	Factors impacting decisions on when to engage in science	Factors impacting decisions on when to engage in science	Factors impacting decisions on when to engage in science	Factors impacting decisions on when to engage in science	1	Several factors that impact decisions about teaching

Culminating Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Fun Other teachers STEM kits			Fun/exciting Volcano kit		2 1 2	More time for reading and math was most noted factor
				Assembly Parent visit Office interruption Kids' behavior One-on-one time with student	1 1 1 1 1	
	Reading and math take most time	Reading and math integration Testing	Field trip More time for reading and math		1 3 1	
Impact of study on instruction Awareness of kits	Impact of study on instruction	Impact of study on instruction Thought about science every day	Impact of study on instruction	Impact of study on instruction Focused on trying to get science in Wants to do more science	 1 2 1	The study impacted co-researchers in different ways
	There is time to teach science Students love science		Paid more attention to standards		1 1	

Culminating Interview Codes, Frequency Counts, and Initial Themes						
Co-Researchers						
Angie	Sawyer	Virginia	Kirby	Carmen		
What Co-Researchers Said					Frequency	Theme
Other items from journal entries	Other items from journal entries	Other items from journal entries	Other items from journal entries	Other items from journal entries		Testing, time, and integration of subjects affect science in the classroom
Favorite topics are those kids are excited about				Favorite topic to teach is butterflies; loves kids reactions	1	
Don't have management problems with hands-on due to engagement					1	
More time was needed for math and writing		More time was needed just to teach			2	
Testing done three times a year	Testing, end of year report cards			Had end of year report card testing	3	
	Integrated science with reading			Integrated science with reading	2	
	Fits standards somewhere; may not be science standards				1	
		No resources			1	

Note: Table presents coding for culminating interviews. Discussion of findings can be found in chapter five.

Co-researchers were asked to keep a journal. Initially the researcher thought having co-researchers write daily about teaching science would be most beneficial.

Realizing that writing daily might take too much time and due to concerns with entries being vague or not addressing the research questions, a template was selected as the means for journaling. The template was created by the researcher, then co-researchers approved it, tested it for one week, and provided feedback before it was officially used for data collection. The journal template is presented in Appendix E and a description of template contents and the rationale for each portion is presented earlier in this chapter.

The final phase of data collection was the culminating interviews, which involved interviewing each of the co-researchers individually after all journaling was completed, with the same methods used for the initial interviews. The researcher then compiled within-case analysis on each person involved in the process, detailing each case and themes within the case. Next, the researcher used cross-case analysis looking for themes and variations, including frequency counts of factors as well as interpretations of meaning (Saldana, 2009).

Data Collection

Data collection lasted eight weeks during spring 2016, with interviews and journals serving as data sources. (See Appendix A for timeline.) Tennessee co-researchers were identified and interviewed approximately six weeks after the Alabama teachers. Tennessee teachers did not pilot the journal template. They began collecting data through the journal template three weeks after the Alabama teachers because the first two systems in Tennessee that gave permission to work with teachers produced no participants. The Tennessee teachers identified as co-researchers were acquired through school system liaisons. Like the co-researchers, the researcher also journaled throughout the course of the study.

Data Analysis

After the interviews had been transcribed by the researcher, the researcher copied and pasted all co-researchers' question number ones together, then question number twos together, then threes, and so on until answers to all questions from the co-researchers were combined into one large document, grouped together by question, which is presented in chapter four. This gave the researcher a broad overview of the study. Next the researcher analyzed each case, looking at each co-researcher's initial interview, journal entries, and culminating interview. The researcher spread these materials out on a table to look for anything that stood out as different from what was coded. The same procedure was followed for each co-researcher and sticky notes were used to record items that made one co-researcher different from the others.

Ethical Considerations

The potential for this study includes advancement of knowledge and understanding about factors that impact kindergarten teachers' decisions about when to engage the natural curiosities of their students in science. The broader impacts include adding kindergarten teachers' voices to the existing literature on teaching science in the early grades. The researcher went through the process of gaining Institutional Review Board approval (including approval by school systems and individual schools), took measures to ensure that all co-researchers remained anonymous, gained consent prior to interviews, and implemented member checks after interviews.

Delimitations

Delimitations for the study included the selection of the Tennessee and Alabama school systems, the grade level, and the teachers used as co-researchers in the study.

Tennessee and Alabama were chosen because the researcher worked in Tennessee for many years and currently works in Alabama. The school systems were selected due to location. The researcher did not select school systems currently visited as part of the researcher's present job responsibilities. Systems were selected that are just beyond those systems. Kindergarten was selected because that is where children enter school as "natural-born scientists," yet their participation in science is limited. Teachers were selected as co-researchers based on their interest in the study, experiences in the classroom, whether they worked in a county or city system, and their participation, or non-participation, as an AMSTI school.

The researcher chose the times and places for interviews conducted with co-researchers, and the researcher selected questions posed. Co-researchers were asked where they would be most comfortable during interviews, in their classrooms or a public establishment. When a public establishment was chosen, the researcher selected the location with the co-researchers' approval. Some interviews were conducted in classrooms. Meeting times for interviews were negotiated between the researcher and co-researchers. Interview questions were created by the researcher and were based on the research questions. The researcher was purposeful about including questions that gave co-researchers opportunities to share information they felt was not addressed by the researcher's questions (Patton, 2015).

The researcher also controlled the time period during which the study was conducted. In addition to interviews, reflection journals were kept by co-researchers under guidelines created by the researcher with input from co-researchers. The researcher chose to have co-researchers collect journal entry data for eight weeks. The

researcher designed the template and chose to have co-researchers log entries daily. The decision was made after conferring with co-researchers.

Limitations

Although interviews gave insight into co-researchers' experiences as educators and journal entries were a convenient method for data collection, the researcher acknowledges that limitations of the study included co-researchers' honesty and willingness to share pertinent information. The researcher did not control the amount or quality of information shared in interviews or journals. The initial interview was important for identifying factors that impact co-researchers' decisions about when they teach science and the conditions for which they engage students' natural curiosities. The researcher acknowledges that factors could exist which were not identified by co-researchers in this study (such as PCK and TCK, which are identified in the literature as factors teachers consider when teaching science). PCK and TCK did not surface during interviews with the co-researchers. It is plausible that co-researchers were not comfortable admitting their lack of content knowledge. Interviews and journals were necessary to capture the exploratory nature of this study and to capture the voices of the kindergarten teachers, but these tools have their limitations.

The researcher also recognized that, because of life experiences, a certain level of bias may have been present and needed to be addressed throughout the duration of the study. Although the researcher had some control over the time period for the study, limitations included waiting for IRB approval and permissions from systems and schools. Waiting for approval and gaining permissions from schools and school systems meant that data collection began later than planned. The end of the school year is not the

optimal time to collect data. There are special school events such as field days that happen at the end of the year; awards programs and testing that occur a few times a year; and end of the year routines like collecting textbooks, cleaning out lockers and desks, and other housekeeping tasks need to be completed. The researcher recognizes that teachers are more likely to be out of their normal routines at the end of the year, which could have affected the data collection process. On the other hand, at the end of the year (after testing) teachers could be more willing to teach non-tested subjects, such as science and social studies.

Summary

In chapter three the researcher described procedures for site selection, co-researcher selection, and the research plan, including the rationale for selecting the Tennessee/Alabama region and how co-researchers were purposefully selected. Initial meetings, first interviews, journal entry collection, and culminating interviews were discussed. The researcher briefly introduced the co-researchers.

Site selections were based on the researcher's past experiences as a middle school science teacher and an administrator in an elementary school in Tennessee, as well as current experiences supervising student teachers in Alabama. Co-researchers were purposefully selected in different ways to ensure a range of experiences. The researcher explored co-researchers' thinking through interviews. In addition to initial interviews, the researcher incorporated culminating interviews to gather data regarding co-researchers' feelings and beliefs about their journal entry data. This gave co-researchers an opportunity to elaborate on and clarify journal data, and helped the researcher understand how co-researchers felt about their role in the study.

CHAPTER FOUR

FINDINGS AND ANALYSIS

This section describes analysis of data and findings from initial meetings, first interviews, journal entry collections, and culminating interviews. Chapter three explained how sites were selected on the basis of the researcher's past experiences in Tennessee and current experiences in Alabama. Co-researchers were purposefully selected in different ways to ensure a range of experiences. In addition to initial interviews, the researcher incorporated culminating interviews to gather data regarding co-researchers' feelings and beliefs about their journal entry data. Co-researchers were introduced in chapter three. Chapter four describes the analysis of data from journal entries and interviews, including the voices of co-researchers as they elaborated on and clarified their perceptions about factors that impact their decisions about when to teach science, conditions in which they engage students' natural curiosities in science, and how they describe engagement in their classrooms.

The overarching research question for the study was: **What factors impact kindergarten teachers' decisions about when to engage their students' natural curiosities in science?** In order to address the overarching research question, three questions emerged:

1. What factors impact teacher decisions about when to teach science?
2. Under what conditions do teachers engage students' natural curiosities in science?
3. How do teachers describe engagement in their classrooms?

There were five co-researchers from four different school systems in northern Alabama and southern Tennessee. Co-researchers were interviewed, kept journals about

teaching science, and were interviewed again at the culmination of the study. The purpose of the study was to gain insight into teachers' thinking as they decide when and how to engage their students in science, to better understand why student enjoyment of science fades in early grades; to contribute teachers' voices to the existing literature on teaching science in the early grades; and to investigate how teachers' science teaching methods align with current research regarding how students learn best. The study began with the selection of co-researchers during initial meetings.

Initial Meetings

Initial meetings occurred in a variety of formats. In the Alabama county system an email was sent by central office personnel to kindergarten teachers, to which one teacher responded with interest. In the Alabama city system, meetings were arranged through the central office and took place with groups of kindergarten teachers at individual schools. The meetings resulted in selection of two teachers from different schools to participate in the study. In Tennessee both co-researchers were identified through two different school district liaisons after working with two other school systems in which no co-researchers were identified. Meetings with individual teachers and groups lasted about 15 minutes and provided details about the study. However, there were no face-to-face initial meetings with the Tennessee teachers; they received information via email. The initial meetings in Alabama were not recorded; however, the researcher took notes and wrote about the meetings afterwards in a journal. Co-researchers identified to participate are listed in Table 8 below.

Table 8. Co-Researchers Identified to Participate in Study

Co-Researcher	Pseudonym	School System Type	Years
2*	Angie, Sawyer	Alabama City System	12, 6
1	Virginia	Alabama County System	26
1	Carmen	Tennessee City System	15
1	Kirby	Tennessee County System	5

Note: Co-researchers' information includes pseudonym, which school system, and number of years teaching experience. *Co-researchers were from different schools.

First Interviews

First interviews with three co-researchers were conducted in classrooms or school meeting rooms. One first interview took place at a Subway restaurant. All but one (with the co-researcher teaching the furthest away) were face-to-face. Completed transcriptions were sent to co-researchers for clarifications, additions, and deletion of content.

Journals

Once the initial round of interviews in Alabama was complete, a journal template was created by the researcher and sent to co-researchers for a trial run and feedback. The trial run lasted one week. Alabama teachers began collecting data on April 4, 2016 using Qualtrics online survey software. In Tennessee, Kirby began collecting data on April 25, 2016 and Carmen began on May 2, 2016. The goal of the journal entries was for co-researchers to record their daily science activities and their decisions about considering and implementing such activities. Journal entries were collected for eight weeks in spring 2016.

Culminating Interviews

After journal data collection ceased, culminating interviews took place with each co-researcher. The primary goal was to understand the views and perspectives of each kindergarten teacher, including how they felt about factors that impacted their decisions about teaching science. After culminating interviews, transcriptions were sent to co-researchers for clarifications, additions, and deletion of information.

Co-Researchers

In this section the researcher introduces each co-researcher or "case," followed by analysis for each case. After introductions, findings are presented in the order of initial interview, journal data, and culminating interview, one case at a time. In other words, Angie's initial interview, journal data, and culminating interview are presented, followed by Sawyer's, then Virginia's, then Kirby's, and finally Carmen's. All of the case findings are combined in a separate section that follows.

Initial interviews were similar to culminating interviews in that both were conversational, with the researcher interjecting with brief comments, asking for elaboration on some answers, and occasionally asking questions "off script." The researcher took a few notes, but mostly paid attention to what the co-researchers said and how they said it. Initial interviews were different from culminating interviews in that they focused on learning more about the teachers personally and on what science looks like in their classrooms. Questions had a "get to know you" feel. Culminating interviews focused on what occurred in the classroom during journal data collection and the study's impact on instruction. Co-researchers had copies of their journal data to review both before and during the culminating interview.

Angie

Angie, a teacher from the Alabama city system, has taught kindergarten for twelve years. She "comes from a family of educators." Her mother was a librarian and her father a middle school teacher. Angie declared early on that she was not going to be a teacher. After taking some courses in law, she decided that education was more appealing, but made another declaration that she was never going to teach kindergarten. While completing her student teaching in kindergarten Angie fell in love with kindergarten. She acquired a job at the same school where she completed her student teaching and has been teaching kindergarten at the school ever since.

Sawyer

Sawyer, a second teacher from the Alabama city system (but from a different school) has been teaching for six years. She knew as early as high school, after babysitting, that she wanted to be in a profession where she could work with children. Teaching was a "natural fit" for her.

Virginia

Virginia, a teacher from the county system in Alabama, has been teaching for twenty-six years. When she was growing up everyone told her she was going to be a teacher. In college she couldn't decide what she wanted to do, but after working in a daycare center for a year, Virginia decided that teaching was what she needed to be doing with her life.

Carmen

Carmen, a teacher from the city system in Tennessee, has been in education for fifteen years. As a child she often visited her aunt's classroom and enjoyed being there,

but in college she pursued nursing. After accompanying her mother, a nurse, to care for an elderly neighbor, Carmen decided nursing was not the profession for her.

Kirby

Kirby, a teacher from the county system in Tennessee, has been teaching for five years. After ten years as a social worker, she decided that social work was not where she wanted to be. She still had a desire to work with children, and teaching gives her that opportunity. Kirby admitted that in teaching she has to deal with some sensitive issues, but nothing like what she did as a social worker.

Individual Co-Researchers' Data

Angie

First interview. The researcher's first interview was with Angie and took place in her classroom. The researcher and co-researcher sat in close proximity at a children's table. Students were in specials. There was much smiling and laughter during the conversation. Angie appeared relaxed and eager to answer questions about what she does in her classroom. She shared that she "comes from a family of educators." Her mother was a librarian and her father was a middle school teacher. She originally wanted to study law. After hearing in one of her college classes all that would be required, Angie went home "crying to my daddy" because she knew she could not do it. She explained that she continued with her classwork and that it took her a long time to finally decide to go into education. She had insisted early on that she would never be a teacher, and was adamant that if for some reason she did go into teaching, she would not teach kindergarten. As part of her teacher preparation program, she found herself student teaching in a kindergarten classroom. She fell in love with kindergarten and when an

opportunity arose for her to teach kindergarten in the school where she did her student teaching, she took it. She has been a kindergarten teacher in that school for twelve years. Angie talked about her journey to become an educator while sitting in her classroom in the same school where she started her career. During the interview it was the researcher's opinion that Angie exhibited pride in her choice to become an educator and was confident in her ability to represent the profession in a positive way.

In conversing about her classroom, she described engagement as gaining and keeping her students' attention. According to Angie, the teacher needs to be the moving object in the room. She said, "I think with kindergarten you have to have their attention and if you're standing still you don't have it because they are not sitting still." She stated that moving around, singing, making real-world connections through literature, and using novelty carefully keeps students engaged in lessons. She mentioned that she often reads to her students to introduce a new topic. She says things like, "Oh wait! Did you see what they just did in the book? We're going to do that too." Students gasp and exclaim, "We're doing something like that!" Angie feels that using literature provides a real-world connection for them.

When it comes to teaching science, if not integrating it into other subjects, Angie said she is lucky to have sixty minutes a week for it. She said that choices are made every day among teaching science, writing, or math because there is no way to do it all. According to Angie, the system has no time requirement for teaching science, so integration is the key to fitting it into the day. This is what she said about her schedule:

Angie: My children do 90 minutes of reading and then we go to PE, then we go to a special[s] class and we have one pretty much every day but Friday. Then we go straight to lunch, so that's another hour and a half of my day.

> Then as kindergartners, I think people understand or know that they can't just sit the rest of the day, so we have 20 minutes of recess. When all that gets factored in I'm down to approximately two and a half hours to try to fit in math, both whole group and small group, writing, and science. We also have rest time here … that 90 minutes of reading really sets the tone for our whole day.

In her classroom, Angie uses AMSTI (Alabama Math, Science, Technology Initiative) kits in addition to STEM (Science, Technology, Engineering, Mathematics) kits that are not from AMSTI. Literature is often integrated with the STEM kits. She described one in which students build a bridge for the Three Billy Goats Gruff, and another in which they build furniture for Goldilocks. She feels that most of the science taught in her classroom uses AMSTI kits, although some units are created by the teacher. However, because the AMSTI kits do not cover all of her standards, she finds other ways to teach those standards (such as working on the STEM kits or the units the teachers create themselves; she specifically mentioned one on magnets). Angie said science videos are often shown during nap time, which helps to fit science in for the day. When asked about how she chooses the method of delivery, Angie replied that she includes teaching STEM for enjoyment. She specifically tries to find activities that her students will enjoy. One activity explores forces and motion using balls and ramps, which leads into a roller coaster system activity. She also uses vehicle building kits when they study transportation; at one station students build a double-decker bus. In a cup building activity the students work as teams to build structures, with castles being the class' current favorite structure. Angie said that she likes it when students are learning without realizing they are learning. She hears them say things like, "We've got to build it taller.

Up, we've got to make it to where there is more speed." She spoke frequently about the necessity to integrate science with other subjects in order to get everything taught.

When asked about integrating science with other subjects, she described a Cat in the Hat activity that uses cups and paper. Students compete to build the tallest tower, and measure it. They also build numbers using Legos, as well as letters of the alphabet. Their Wonders Reading series regularly uses science-related nonfiction texts. Examples included texts about the sun, plants, and transportation.

Journal entries. Angie logged 33 entries from April 4 through May 19, 2016. Science was taught on 25 of 33 days (76%), and taught independently on 25 of 25 days (100%), meaning it was not integrated with another subject. The researcher found this interesting in light of the emphasis that was placed on integration in the first interview. Science lessons were planned on 25 of 25 days (100%), as opposed to happening spontaneously. The lesson matched science standards on 23 of 25 days (92%). The science lesson was part of a kit on 15 of 25 days (60%). According to the co-researchers' journal comments, topics included weather, including the five senses, temperature, and types of clouds; Earth Day, mainly recycling; matter; the sun, including building a structure to block the sun; STEM exploration activity stations; and bubble exploration. On a scale of 1 to 10, with 10 being the favorite topic to teach and 1 being the least favorite, she scored most of the topics as her favorite things to teach. She recorded eight days in the 10 range, ten days in the 9 range, six days in the 8 range, and one day in the 6 range (see Table 9).

Table 9. Number of Days Scored for Most to Least Favorite Topic to Teach

Rating Scale	10 Most	9	8	7	6	5	4	3	2	1 Least	Total
Days Taught	8	10	6	0	1	0	0	0	0	0	25

Note: When rating the lesson taught that day on a scale of 1 to 10, with 10 being the co-researcher's favorite topic to teach and 1 being the co-researcher's least favorite topic to teach, the table shows the number of days a lesson was taught at that particular rating.

Angie shared that the topics she scored highest were the ones the kids seemed most excited about, which made her excited to teach it. The topics with lower scores are topics she feels she has to teach in order to get to something else.

Table 10. Topics Taught in Order by Number of Days Spent Teaching

Topic (as described by co-researcher)	Days Taught
Weather, including the five senses, temperature, and types of clouds	10
The sun, including building a structure to block the sun	6
Earth Day, mainly recycling	4
Matter	3
STEM exploration activity stations	1
Bubble exploration	1

Note: The co-researcher listed the topic that was taught each day. The table shows the number of days each topic was taught in order from most often to least often.

On the few days science was not taught, the factors that impacted her decision not to teach it included an assembly (one day), testing in reading and math (three days), more time was needed for writing and math (four days; also marked as a secondary factor on one day), students needed a longer rest time (two day; a secondary factor).

Table 11. Factors That Impacted Decisions about Teaching Science

Factors	Primary	Secondary	Total
Assembly/pep rally	1	0	1
Reading/math testing	3	0	3
More time needed for another subject	4	1	5
Longer nap time needed	0	2	2
Resources not available	0	0	0

Note: Factors that impacted decisions about teaching science broken down into primary and secondary factors as reported by the co-researcher.

Culminating interview. The culminating interview took place in a Starbucks café near Angie's school. This was the second interview of the day for the researcher. The researcher gave Angie the data analysis from her journal entries and allotted a few minutes for review. Angie noticed that a majority of her entries included the use of kits in her lessons, and that only two lessons were not standards-related. These lessons included the five senses and bubbles. The five senses used to be a kindergarten standard, and her team felt it was still important to teach. Bubble day was for fun; students completed activities at several stations in which they explored the properties of bubbles. At one station they used kitchen utensils to see what types of bubbles each one produced. They worked on bubble painting at another station. They also had a station where they made their own bubble wands.

In planning her lessons, the main considerations were time and resources, as well as sometimes changing the lesson to make it kindergarten-friendly. Regarding time, Angie said she tries to determine how much time she needs in order to complete the

lesson. She also considers whether the lesson can be done all at once or if multiple days are needed. Factors that impacted her decisions included the availability of AMSTI kits and whether the lesson would be fun for students. Kits are rotated among schools in the system. Some portions of the AMSTI kits are not kindergarten-friendly, so she had to find time to tweak some of the lessons to make them grade-appropriate. She taught one lesson, Sunny Sandbox, because the neighboring teacher wanted her to teach it. She also considered the standards and when one had not yet been taught, she knew it needed to be done.

Angie felt that her science activities went as planned. Students were able to complete all of them, and obtained the expected results. Levels of engagement were high, with lots of movement during activities. For example, students got into groups to discuss the fact that when their bodies were all together they were like a solid. When they moved apart a little they were more like a liquid and when they spread across the room they acted more like a gas.

Participating in the study made Angie more aware of the fact that she used the kits quite often. She suggested that this was because all the resources were right there and ready to use, making her preparation much easier. She said, "I honestly don't know that I could create as many hands-on activities as they get without those kits because the resources are just right there … it's one less thing for me to worry about."

Angie shared that behavior management was not an issue when conducting hands-on investigations, as she feels many teachers think. She said:

Angie: When they are sitting and they're not allowed to get up and they don't have their hands on anything, you're constantly saying do your work, do your work, come on, let's go. We've got to hurry, we've got to hurry.

> When you get them in science situations … where they are building a structure you have less behavior problems because they are actively engaged.

Instead, behavior was much easier to manage during science lessons because students were actually doing something instead of sitting in their seats. They were engaged.

Angie's journals indicated that more time was needed for another activity. When asked, she shared that students were involved in a writing activity for Mother's Day. This took multiple days of working with students in small groups to write thank you letters. One day time was spent on math games, which took more time for prep and cleanup, according to Angie. She said that "A lot of days the math games have such a big cleanup or prep that it's hard to do the prep for the math games and the prep for the science and get it all cleaned up and move on to the next one and get everything in." Finally, she talked about the benchmark testing they did in reading and math. It was performance series testing that occurred at the beginning, middle, and end of the year. She said that at the beginning of the year testing usually takes longer because students have to get used to manipulating the mouse to move the cursor to click on the bubble. She explained that much of the technology used today is touchscreen, so young children are not used to the mouse.

The interview ended with Angie stating that she wished there was more integration of science with other subjects. This may have been a missed opportunity for elaboration on the conversation that happened earlier in the interview.

Sawyer

First interview. The researcher met with Sawyer in the same meeting room in which the initial informational meeting took place. Sawyer sat on the other side of a large conference table and smiled often, but responded to questions with brief answers, rarely elaborating with details. There was some laughter during the conversation. Sawyer shared that she had been teaching for six years and that in high school she loved babysitting. She knew she wanted to do something where she could continue to work with children. She agreed that teaching was a "natural fit" for her.

When asked about student engagement, Sawyer shared that she recently attended training on whole brain teaching. She said it changed what student engagement looks like in her classroom compared to the past five and a half years. She now uses a lot of echo responses, which helps keep students focused on what she says to them. She likes it because it does not single out a specific child, but provides a "good little check to see who's focused and paying attention and if they're not as a whole group responsive, it provides that backup that kind of refocuses them."

When it comes to science, Sawyer teaches for approximately 30 minutes a day, or about 2.5 hours a week. She also admitted that that is best case scenario. She said, "Our science is in the afternoon, so if we have assemblies or pep rallies or anything, then it's tough to get that 30 minutes pushed in the schedule throughout the day another way." There is no requirement for teaching science, but she says the more they can get in the better. "At least they are getting something instead of nothing." In addition to pep rallies and assemblies, another factor that limits the amount of time available for teaching science is rest time. Sawyer says, "If it's been a rough day and more of them are resting

and it takes longer to get up, get packed up, get moving, it cuts into that social science time."

Decisions about what to teach in science are focused around seasons and holidays. When AMSTI kits arrive, teachers try to work them in. They spend one week a month on the AMSTI kits and the other weeks on seasons and holidays. One example given was the Martin Luther King, Jr. holiday. Sawyer pointed out that although it is not a science lesson, they spend that social science time before the holiday teaching students what the holiday is about so they can attempt to understand that there's a reason they are not at school. Sawyer's method of delivery for teaching science depends on the makeup of her students. She shared that in some years students can handle more exploration, while in other years students need a bit more structure.

Sawyer explained that science is integrated with other subjects by studying the holidays. It is also integrated with math. An example given was a book the class read recently called *How Many*, which had snails and different animals in it they could talk about. Sometimes in their reading stories they can find something to pull out and talk about.

When asked what else she wanted to share about teaching science in her classroom, Sawyer talked about reminding herself that students are five and that you have to "let go" sometimes. She described an activity about rain and raincoats in which students were given cups and told to try different materials on top of the cups that would either repel water or let it seep in. She said:

Sawyer: The first time I did it I was so high-strung about it, for lack of a better phrase, because I didn't want any spills and I didn't want the water to go

> everywhere and I wanted everyone to put … and I thought wait a minute, they're five. If it spills, it spills. It is water.

She explained that by letting go she has found that students explore and create or come up with things that she couldn't have taught them or guided them to do.

Journal entries. Sawyer logged 24 journal entries from April 4 through May 19, 2016. At one point a week went by with no logs and an email reminder was sent. She went back and logged the week from memory using lesson plans as a guide. Sawyer taught science on 18 of 24 days (75%), and 17 of 18 of her lessons (94%) were independent lessons. One lesson was integrated with reading. One lesson was spontaneous, while the other 17 (94%) were planned. Twelve of her 18 lessons (67%) related to a state science standard, none were part of a kit. She taught about spring, baby animals, Earth Day, Earth, Mother's Day, plants, and summer safety. These scored from 6 to 9 on a scale of 1 to 10, with 10 being a favorite topic to teach. Factors that impacted her decisions about teaching science included more time needed for another subject, an assembly, and more rest time needed for students (see Table 12).

Table 12. Number of Days Scored for Most to Least Favorite Topic to Teach

Rating Scale	10 Most	9	8	7	6	5	4	3	2	1 Least	Total
Days Taught	0	7	5	4	2	0	0	0	0	0	18

Note: When rating the lesson taught that day on a scale of 1 to 10, with 10 being the co-researcher's favorite topic to teach and 1 being the co-researcher's least favorite topic to teach, the table shows the number of days a lesson was taught at that particular rating.

Table 13. Topics Taught in Order by Number of Days Spent Teaching

Topic (as described by co-researcher)	Days Taught
Earth/Earth Day	6
Baby animals/ducklings/animals	4
Families/Mother's Day	3
Spring/plants	2
Summer safety	2
Spring	1

Note: The co-researcher listed the topic that was taught each day. The table shows the number of days each topic was taught in order from most often to least often.

Table 14. Factors That Impacted Decisions about Teaching Science

Factor	Primary	Secondary	Total
Assembly/pep rally	0	2	2
Reading/math testing	0	1	1
More time needed for another subject	5	1	6
Longer nap time needed	1	1	2
Resources not available	0	0	0

Note: Factors that impacted decisions about teaching science broken down into primary and secondary factors as reported by the co-researcher.

Culminating interview. Sawyer's interview was the first culminating interview conducted and took place at a Starbucks café near Sawyer's school. She was given her journal entry data along with a few minutes for review. In reviewing her journal entries, Sawyer noticed that she taught science more often than she thought and that most of her lessons were taught independently.

When asked what she takes into consideration in planning science activities, Sawyer said she thinks about hands-on lessons. She explained that her students love to learn through play and exploration and that the "arts and crafts kind of feel" is more popular with her students. She said that when they are happy it is a lot easier to teach them. Sometimes her activities take longer than expected and have to be finished the next day. She feels her students' levels of engagement are high because they are doing something different every day and don't get overwhelmed, bored, or frustrated.

The primary factor that impacts her decisions about when to engage her students in science, according to Sawyer, is her schedule. The schedule was established at the beginning of the year with her team of kindergarten teachers. She explained, "The core subjects of reading and math had specific time allotments that we had to teach, so we filled them in first, then we put in our lunch time, and specials, and PE time, and play time in and then rest, and then there was about a 30 minute span at the end of the day." When asked how this study has impacted her science instruction, she said that it did have an impact. She realizes that there is time in the day and that students love to interact and participate in science lessons. She expressed feeling guilty that she had not made it a higher priority before participation in the study.

The researcher asked about the reading lesson she integrated with science. Sawyer explained that her class read *The Little Red Hen* and a nonfiction book called *Bread Talks*. They talked about different kinds of bread and who makes the bread. In *The Little Red Hen* there was a part about the hen sowing her seeds. Because they had already studied their plant lessons, students understood what sowing meant and were excited to make the connection. When the researcher asked about the spontaneous lesson

mentioned in the journal, Sawyer said when her class was on the playground they kept bringing her flowers and identifying all the parts of a plant, which they had studied earlier. She mentioned that this went on for weeks.

Some of the science lessons taught were not standards-related. When asked about this Sawyer explained that sometimes the lessons are based on reading and math standards, but have science components. Some things they teach do not connect to any standards, however; examples given were Mother's Day and summer safety.

One reason for not teaching science mentioned in the journal was testing. When asked, Sawyer said, "Our report cards are a skills-based report card, so all skills are one-on-one with the teacher. [There are] about 24 to 25 skills to test for each child." She shared that "kindergarten gets together every summer and makes sure it [the test] fits the standards." She mentioned Wednesday Round Up, which occurs every two weeks, and clubs, which occur four times a year, as other factors that impact teaching science.

Virginia

First interview. The first interview with Virginia took place at a Subway restaurant between her school and the researcher's home. Both traveled 30 to 40 minutes to meet. There were a few patrons in the restaurant and music was playing, but the conversation was easy to hear. Virginia sat in a booth across the table from the researcher. She arrived a few minutes after the researcher and appeared to be confident and friendly. Virginia has been teaching for 26 years and is the most experienced of the co-researchers. When asked about why she decided to become a teacher, she shared that growing up everyone told her they thought she was going to be a teacher. She could not

decide, even in college. But after working in a daycare center for a year she decided that she wanted to work with children. She wanted to be a teacher.

The researcher asked Virginia about engagement in her classroom. She said that she uses the Promethean board, music and videos, and manipulatives, and works with children in small groups to keep them engaged. She said she purposefully tries to "hit all the modalities: the kinesthetic, auditory, and the visual." She laughed a little when asked about weekly time spent teaching science. She guessed maybe two hours a week, but exclaimed, "That might be pushing the envelope a little bit because we incorporate so much." She does not really teach just a science lesson. One example she gave was studying animals using videos. She mentioned that her school system has no requirement for teaching science, but they do follow a continuum.

In discussing factors that contribute to the amount of time spent teaching science, she said:

Virginia: Right now everything is so focused on reading and math ...We have an uninterrupted hour and a half to two hours every day of reading. Then we have to have an hour of math. In kindergarten that doesn't leave a lot of time to do other things ...We have to do one-on-one testing two times … [each] nine weeks. So, every month we're taking almost a week of teaching just to do testing. [It takes] about a week because you have 20 students and it's one-on-one, so it's about … an hour on each child [to test] … That's not including your DIBELS progress monitoring, and that's not including … Global Scholar … performance series testing is what it's called … and it's just for math for us.

Virginia explained that she uses the standards to decide what to teach in science. She mentioned that "with kindergarten they tell us we can do the bare minimum. We don't have to add anything." She expects that to change when the state adopts new science standards soon. Her method of delivery for science content is through hands-on

activities that are part of thematic units. She stressed again that science is not taught as a separate entity, but is integrated into other subjects. She explained that since it was late in the afternoon of a busy day, she was unable to give examples at the moment. Virginia also said science standards were covered earlier in the year, so they were not teaching much science during the current nine-week period.

Virginia was excited to share that she would be attending AMSTI training over the summer. She commented that the teachers were looking forward to it because they feel that currently science instruction is "hit or miss." She believes they will teach science more consistently after they receive the AMSTI training.

One of the activities Virginia does in her classroom is talking about day and night and things in the sky using the book *It Looked Like Spilt Milk.* They do an activity with clouds to go along with the book. She also incorporates other books and science vocabulary.

Journal entries. Virginia logged 17 journal entries from April 4 through May 19, 2016. Science was taught on 2 of 17 days (12%). Both times it was integrated with reading, was a science standard, and was planned. Lessons were not part of a kit. She taught the day and night sky and rated the topic a 9 out of 10 as far as favorite things to teach.

Primary factors for not teaching science included more time needed for another subject, testing, resources not available, and an assembly. In the comments section of her journals, Virginia elaborated on reasons for not teaching science, which included progress monitoring using DIBELS, math review and progress report testing, teacher

attendance at a workshop in the morning and students had PE and library that day, one day was a half day, and one day was field day.

Table 15. Number of Days Scored for Most to Least Favorite Topic to Teach

Rating Scale	10 Most	9	8	7	6	5	4	3	2	1 Least	Total
Days Taught	0	2	0	0	0	0	0	0	0	0	2

Note: When rating the lesson taught that day on a scale of 1 to 10, with 10 being the co-researcher's favorite topic to teach and 1 being the co-researcher's least favorite topic to teach, the table shows the number of days a lesson was taught at that particular rating.

Table 16. Topics Taught in Order by Number of Days Spent Teaching

Topic (as described by co-researcher)	Days Taught
Sky	1
Day and Night Sky	1

Note: The co-researcher listed the topic that was taught each day. The table shows the number of days each topic was taught in order from most often to least often.

Table 17. Factors That Impacted Decisions about Teaching Science

Factor	Primary	Secondary	Total
Assembly/pep rally	1	0	1
Reading/math testing	5	0	5
More time needed for another subject	6	5	11
Longer nap time needed	0	1	1
Resources not available	3	4	7

Note: Factors that impacted decisions about teaching science broken down into primary and secondary factors as reported by the co-researcher.

Culminating interview. Virginia's culminating interview took place on the same day as the other Alabama teachers' interviews and was the last one of the day. The researcher and Virginia met at a camp where Virginia was coaching a group of cheerleaders. Virginia was given her journal entry data with a few minutes to review it. In reflecting on her journal entries, Virginia noticed that she did not teach science as much as she thought she did. She mentioned that when she sat down to write in her journal, it sometimes crossed her mind that the researcher would think she does not teach much science. She said that seeing it on paper really made her realize she was not teaching it.

When Virginia plans science she considers where it will fit in with reading and math. Regarding students' levels of engagement, she said that it is pretty good. She discussed reading books and watching videos and shared that she has them "trained pretty well by the end of the year, so they can sit more and do more."

One of the factors that impacts her decisions about when to engage students in science is testing. They use Global Scholar for math, a performance series test that takes about 45 minutes to administer. They also administer DIBELS in reading, which takes approximately half a day. In addition they administer common assessments, which take about one hour per child. This is done twice every nine weeks. Virginia stated that approximately 2 weeks every 9 weeks are "lost on testing." She shared that they've never been able to look at the testing booklets after testing was over. She said:

Virginia: They take our testing booklets and then they put them on a shelf and we never get to look at them, so I'm actually reading a book I just told you about, *I've DIBEL'd, Now What?*, and it's showing me how to go and look at their books and read and find out where their errors are so that I can go back and reteach to their errors instead of just saying oh, they scored intensive. Well … Why did they score intensive? What did they not know? We've never been able to get that but they said now we can go look at our test booklets at any time.

Virginia explained that they were getting data, but not using it. She shared that the data they get from Global Scholar, at least at the beginning of the year, is inaccurate because her students cannot read the questions and some questions are not read to them. She shared that one student scored the second highest in kindergarten even though they could not even count to 20. She said the student just guessed. Virginia questioned the validity of the test. She shared, "I've actually written a letter to the company and the representative has been in touch with me and he's met with me to discuss problems with the testing … I just think it's too much testing for kindergarten. To facilitate learning you need to be teaching. You need to be working with the kids. I'm not getting to because I'm testing so much."

When asked if she ever feels, throughout the school year, that she gets to really teach, Virginia stated that at the beginning of the school year she gets to teach all the time. She says it is the in third and fourth 9 weeks that they feel they are "drowning sometimes." She believes if we had conducted the study at the beginning of the year, it would have shown more science in the classroom because they really got to do a lot. When the researcher asked Virginia about continuing the study the next school year for the entire year, she expressed interest in participating in the study.

Virginia's journal entries indicated that one factor that impacted her decision to teach science was availability of resources. When asked to elaborate, she stated that they don't have anything for science. She said, "Anything that we teach, use, or do, we have to come up with on our own because our science curriculum is about neal and nault for kindergarten." She added, "We're getting the AMSTI, so I feel like it's going to be better next year. We just didn't have anything."

When asked if there was anything else she would like to share, Virginia said, "I was just amazed at how much I did not teach science … well, when I sat down every day, I was like, ooh, I didn't teach science today ... I kind of knew it going in, but now I really realize … when you see the data, it's a lot different."

Kirby

First interview. Kirby assumed the role of co-researcher after a school system liaison known by the researcher, who is also a teacher, walked down the hall to Kirby's classroom and asked her if she would be willing to participate in the study. Emails were exchanged between Kirby and the researcher to set up initial contact, which was the first interview. The interview took place in Kirby's kindergarten classroom where Kirby

shared that she went into education after several years as a social worker. She took classes online and earned her master's degree along with what she needed for a regular education degree. She shared that her first couple years were a little rough because things were always changing, so each year felt like her first year again.

Kirby keeps students engaged in her lessons by using a lot of music videos, allowing students to get up, dance, and move around the classroom. She uses a video every day in reading and in math and she can tell the students are engaged because they are excited. Science is not taught by itself. She said:

Kirby: We don't really teach science by itself … there are science standards that are included in some of the reading material that we do … it's really not allotted into our schedule anymore … even when we did have it allotted into our schedule … science and social studies both were at the same time [on a rotating schedule] so we had to alternate week to week when we were teaching [it]. It was only about 30 minutes … it wasn't a great deal of time to do a whole lot of anything with … now that we have a 90 minute block for reading that's really the only time we can fit that in. We try to find things that we can read or look at that are science-based.

When Kirby first started, teachers taught science from a curriculum, but it is no longer allotted for in the schedule. She said they don't have time to check to make sure they are covering the standards; in fact, she knows they are not covering them.

When asked about factors that contribute to the amount of time spent teaching science, Kirby mentioned Response to Intervention (RtI) and having a 90 minute reading block. She said that one of the standards they have for science is calendar, and they do that every day. They talk about the days of the week and seasons. In their reading series they talk about beavers and other animals. When the kindergarten teachers mapped out their English Language Arts standards, they selected fiction stories and added some nonfiction to help cover science standards.

When the researcher asked about testing, Kirby said they administer DIBELS and STAR Early Literacy tests, all ELA based. At this point in the interview an alarm sounded for an announcement saying that the state science tests would not be in as expected. Resuming the conversation, Kirby shared that her school began taking grades in kindergarten a year ago and they started taking grades on tests as well.

The researcher asked Kirby how she decides what to teach in science. She explained that when teachers map their curriculum for the year, they map according to the alphabet they are going to teach. She said, "For instance, when we did our mapping, we did the letter 'p', we decided to put penguins with the letter 'p'. We talked about penguins. We looked at some seasonal factors, what time of year it was. What holidays were coming around [soon]. That kind of thing." Kirby's phone rang and the discussion ended after the researcher asked if there was anything else to add.

Regarding the method of delivery for content, Kirby said she delivers through reading and writing and had nothing else to add when asked about integration of science with other subjects. She had already discussed calendar time. When asked if there was anything else she would like to share, Kirby said, "I guess I wish we had just a little more time to do some things because, you know, a lot of the experiments and stuff like that we don't really have a lot of time to do some of that." Kirby said the only experiment she conducted was a volcano model that she brought in so the children could watch it erupt. She said, "We have 90 minutes for reading and we have 90 minutes for math and then we have RtI [Response to Intervention]. That's a 45 minute block and by the time we have lunch and activity, you know, all of that, there's really no time left."

The interview ended with a brief conversation about the importance of nap time at kindergarten age. Kirby's school is in rural Tennessee and does not have nap time, but some of the schools in Alabama have it.

Journal entries. Kirby entered data in her journal for 16 days from April 25 through May 19, 2016. She taught science on 7 of 16 days (56%). Of the seven lessons, one was independent and the other six were integrated with other subjects—four with reading and two with social studies. Six days were planned and one happened spontaneously. The spontaneous lesson was about transportation. All lessons were tied to the state science standards and one (the volcano) was part of a kit. She taught transportation, parts of plants, animals, and heredity. The class also attended a field trip to a hands-on science center. She rated the topics from a 4 to a 9 (out of 10) as far as favorite topics to teach. Animals are her favorite topic to teach and transportation her least favorite.

Table 18. Number of Days Scored for Most to Least Favorite Topic to Teach

Rating Scale	10 Most	9	8	7	6	5	4	3	2	1 Least	Total
Days Taught	0	1	0	2	2	1	1	0	0	0	7

Note: When rating the lesson taught that day on a scale of 1 to 10, with 10 being the co-researcher's favorite topic to teach and 1 being the co-researcher's least favorite topic to teach, the table shows the number of days a lesson was taught at that particular rating.

Table 19. Topics Taught in Order by Number of Days Spent Teaching

Topic (as described by co-researcher)	Days Taught
Transportation (least favorite)	2
Heredity, how plants and animals live	1
Parts of a plant	1
Multiple topics, field trip to science center	1
Plants	1
Animals and heredity (favorite)	1

Note: The co-researcher listed the topic that was taught each day. The table shows the number of days each topic was taught in order from most often to least often.

When asked about factors that impact her decisions about when to teach science, Kirby responded that more time was needed for reading six times, they were testing two times, and there was an assembly one time.

Table 20. Factors That Impacted Decisions about Teaching Science

Factor	Primary	Secondary	Total
Assembly/pep rally	1	0	1
Reading/math testing	2	0	2
More time needed for another subject	6	0	6
Longer nap time needed	0	0	0
Resources not available	0	0	0

Note: Factors that impacted decisions about teaching science broken down into primary and secondary factors as reported by the co-researcher.

Culminating interview. Kirby's culminating interview took place at a Subway restaurant near her school. A few patrons filtered in during the course of the interview. Near the beginning of the interview both the researcher's and co-researcher's eyes began burning and watering. We assumed that onions were being cut. It had a minor effect on the interview in that we discussed it a couple times. We were pretty uncomfortable, but able to finish the interview and visit for a few minutes afterwards. Kirby's interview was the last for the study. She was given her journal entry data and a few minutes to review it. When asked what she noticed about her journal data, Kirby said she noticed that she had to "fit science in somewhere else," meaning she had to integrate it with another subject. She also mentioned, "I know that we're not covering all the standards. It's impossible." When planning lessons, she considered what she would be doing in reading and worked to incorporate science there. She taught her students about plants (specifically parts of a flower) and animals. In teaching animals, she focused on how parents and offspring look similar. Most of her activities were "question-type" that went along with the reading story. Her students enjoy hands-on activities. The two she did were planting flowers and watching the volcano erupt. They were studying the letter "v" when they watched the volcano.

When asked about factors that impact her decisions about when to engage her students in science, Kirby shared that when she thinks of something exciting that she believes the students will like, she does it. She incorporated science into reading, but she also incorporated it into social studies (including studying the state bird and flower). She said:

Kirby: I know we talked quite a bit about the state bird and the state flower, talking about the flower parts. We watched some videos about the mockingbird. That kind of thing … That's what it was, though, we studied the mockingbird in pretty good detail, and also the iris. You know, they had to color a picture and make it look like what a real iris looks like. We talked about the stem and the leaves and all of that kind of stuff.

One journal entry noted a spontaneous lesson. Kirby could not remember what the lesson was, so we talked about adding a place for a description in the journal template, should we continue with the study. Kirby talked about the class trip to the hands-on science center where students learned about shadows, animals, sound waves, and more. She feels participation in the study made her focus on the science standards more than before. She also feels it will impact the next year because she will be more aware of the science standards and how she is teaching them. She is curious to see how students in her school do on the state science tests once they move into testing grades, but afraid that scores will reflect students' limited exposure to science.

Carmen

First interview. After two attempts to schedule a face-to-face meeting and one attempt at a phone interview, Carmen's first interview ended up being conducted via email. Carmen was added as a co-researcher after another school system liaison known by the researcher contacted her to find out if she would be willing to participate in the study.

Carmen originally majored in nursing. She accompanied her mother to help care for an elderly neighbor, but after changing bandages for bed sores, she decided nursing was not the right profession for her. She has an aunt who is a teacher and as a child she enjoyed spending time in her aunt's classroom.

On the question about student engagement, she said:

Carmen: This is different for each student. It ranges from simple paying attention to often times standing up because they are excited about what we are learning. A couple struggle with ADHD, so allowing them to move around or hold an item helps them tremendously. More specifically, engagement is participation.

Carmen spends approximately 20 to 30 minutes a day on science during the weeks she teaches it. She alternates science with social studies. Her school system does not have a time requirement for science, but according to Carmen it is understood that science will be incorporated into reading and math lessons.

Carmen's class is different from the other co-researchers' classes because science is taught first thing in the morning. The researcher saw this as a promising realization until the rationale was explained. Some students eat breakfast in the classrooms in the morning and because some are eating and some are not, core subjects such as reading and math cannot be taught. Reading and math have to be taught when everyone can participate with no distractions, so science is taught in the morning. All students can watch a video, including students who are eating, and a discussion takes place afterwards.

Factors that affect the amount of time spent teaching science include how long it takes to eat breakfast, whether a program or assembly is scheduled, and unexpected visitors or interruptions. When deciding what to teach in science, Carmen and the other kindergarten teachers plan the curriculum together. They pick themes that correlate with the standards and the seasons and months. Regarding the method of delivery, Carmen stated that it depends on the amount of time that can be devoted to the lesson. She said that "delivery can range from simple introductions through a video to a hands-on experiment," the latter of which she prefers.

Journal entries. Carmen collected data for the least amount of time, 9 days, from May 2 through May 19, 2016. She taught science on 3 of 9 days (33%). Two lessons were independent and one was integrated into another subject (reading). All three lessons were planned and related to the state science standards. They were not part of a kit, and all were about the butterfly life cycle, which rates high as her favorite topic to teach. She gave the butterfly life cycle a 9 out of 10 rating.

Table 21. Number of Days Scored for Most to Least Favorite Topic to Teach

Rating Scale	10 Most	9	8	7	6	5	4	3	2	1 Least	Total
Days Taught	1	2	0	0	0	0	0	0	0	0	3

Note: When rating the lesson taught that day on a scale of 1 to 10, with 10 being the co-researcher's favorite topic to teach and 1 being the co-researcher's least favorite topic to teach, the table shows the number of days a lesson was taught at that particular rating.

Table 22. Topics Taught in Order by Number of Days Spent Teaching

Topic (as described by co-researcher)	Days Taught
Butterfly life cycle	3

Note: The co-researcher listed the topic that was taught each day. The table shows the number of days each topic was taught in order from most often to least often.

Factors that impacted her decisions about when to engage students in science included testing, an assembly one day, and more time needed for another subject. The researcher was concerned about the small amount of data collected by this co-researcher, and wondered about its significance. The culminating interview turned out to be very

telling with the concept of spontaneous interactions emerging from the conversation. This would not have occurred if the other data had not been collected and discussed during the interview.

Table 23. Factors That Impacted Decisions about Teaching Science

Factor	Factor	Factor	Total
Assembly/pep rally	1	2	3
Reading/math testing	4	1	5
More time needed for another subject	2	1	3
Longer nap time needed	0	1	1
Resources not available	0	1	1

Note: Factors that impacted decisions about teaching science broken down into primary and secondary factors as reported by the co-researcher.

Culminating interview. The culminating interview was the first meeting between Carmen and the researcher. It was also the first culminating interview among the Tennessee teachers and took place at a Subway restaurant halfway between the researcher's and Carmen's residences; both traveled about 45 minutes. Carmen was very friendly, smiling throughout the interview and asking for clarification and repetition of questions to be sure she answered everything fully. She was given her journal entry data by the researcher and given a few minutes to look it over. When asked what she noticed, she said that she must teach science first thing in the morning or it will not happen. She said she teaches it in the morning because:

Carmen: Part of the reason I do that is because we have, our school and our system, but our school mainly has taken on a grant where we have to do breakfast

> in the classroom, so the kids are eating and we're not technically supposed to be doing work. That way if there are children that are not participating in the breakfast program, they don't view it as being punished because they're doing work while everyone else is eating breakfast. So, I usually incorporate some kind of science or social studies video or a Brainpop Junior lesson. Then, everybody can watch it while they're eating or not eating and then when it's finished we can kind of talk about it and elaborate and then maybe pull out our journals and write about it … Otherwise, we'd be sitting there staring at each other and not be getting started until 8:30 to 8:45 some mornings.

When the researcher asked what she takes into consideration in planning lessons, Carmen stated it was mainly their attention span. She wants activities that will hold their attention the longest, or have them most actively engaged. She looks for something that will "stimulate their brains and get them going." Most of her science lessons went as planned. Some went off course, but in a good way. When asked to elaborate she talked about students asking about the red liquid on the butterfly net when the butterflies hatched. She explained the meconium even though she had not intended to discuss it with them. They began talking about animals that lay eggs, which brought them back to a previous lesson where she taught them what oviparous meant. This led them a discussion of things they could look for over the summer in the yard, or visiting the zoo.

Carmen shared that things come up in the mornings that keep them from having a science lesson. Children are pulled out for RtI (Response to Intervention) testing; she also completes testing in the classroom. When asked about testing she elaborated that she completes benchmark testing three times a year. The testing is called STAR early literacy. Other things that come up during the school year, although not during the few days she participated in the study, include assemblies, parent interruptions, office

messages and requests, students needing one-on-one attention, and students being wound up, as in the whole class.

Carmen said that student engagement is high for science. At first she attributed it to science being taught first thing in the morning, but after sharing that students are not as engaged in social studies unless there is something to cut and paste, she decided it is probably more about the activities.

When asked how the study has impacted her science instruction, if at all, she said that she noticed she was more focused on really trying to get science in each day. She felt it was necessary in order to "get some decent research." She shared that she had a rough year last year and did not get to teach as much science as she wanted. She loves science, and talked with the kindergarten team about making an effort to incorporate more science and social studies this year. She said she did better, but still not what she wanted. When asked what science would look like if she did not have to worry about all these other factors, she said:

Carmen: I would like to do more, like start the week, introduce a science lesson, then build on it a little bit each day. Maybe start with a story or a video and then progress through with writing and then some discovery of some sort, but then I want to end it on Friday, like a fun Friday. Here's our big experiment. Now we're going to take everything you have learned … let's see what really happens.

This is when they would "test out" what they had been learning about all week. Students would take everything they learned and apply it. The researcher asked if it could occasionally be done differently, such as doing a big exploration to begin and spending the week finding out more about it. She liked that idea as well.

Carmen said she loves teaching science. She said, "If I could teach everything through a science lesson, I probably would. Which I probably could." She shared how much she loves when her students rush in to see how the butterflies are doing or to see which of the gummy bears, soaking in various solutions, dissolved. She would like to know how other teachers get everything in for the day, including reading, math, writing, science, and social studies. She said, "I just want to make it better. I want to do more with it. You know, I would love to have, I'm so amazed at those teachers that can work it in, like the stations, you know. How do they squeeze it in? How do they have time to incorporate the science stations along with reading and math?"

Towards the end of the interview, the researcher asked about taking students outside to explore. Carmen said they have two recess times a day and at the beginning of each recess they walk two laps around the track. She said they talk about what they hear, smell, and see. It is during these times that students pick up various objects and show them to her. They have found robin eggs, which lead back to the big word they learned, oviparous. They have also found feathers. She shared that one student brought her a twig and asked if it was a dinosaur bone. They discussed how it looked like a bone and then she asked them if they thought it could really be a dinosaur bone. One of the most compelling comments came from this conversation in the interview when the researcher said, "It sounds like you have a lot of student-initiated things you talk about." She said, "I do. You know, the more I think about it, I don't even realize it because it is just day-to-day conversations you have, but it is initiated by them a lot."

First Interviews Combined Analysis

In conducting initial interviews, the researcher asked historical professional questions, including the teachers' number of years in and reasons for joining the profession. The number of years teaching ranged from 5 to 26 years (5 Kirby, 6 Sawyer, 12 Angie, 15 Carmen, 26 Virginia).

Table 24. Number of Years Teaching Experience

Co-Researcher	Teaching Experience in Years
Kirby	5
Sawyer	6
Angie	12
Carmen	15
Virginia	26

Note: Teaching experience spans from 5 years to 26 years.

The reasons for becoming teachers were either family members who were teachers (Angie, Carmen) or previous enjoyable experience working with children (Sawyer, Kirby, Virginia). Of the five co-researchers, none had aspired early on to be a teacher.

Next, the researcher sought to ascertain co-researchers' ideas of engagement. All five co-researchers spoke about gaining and keeping students' attention. Different ways of doing so included using music and videos (Angie, Kirby, Virginia), movement (Angie, Carmen, Kirby), and manipulatives (Carmen, Virginia); also using books and eliciting echo responses.

Regarding the amount of time spent weekly teaching science, co-researchers observed that at some point it had been alternated weekly with social studies (Carmen, Kirby), or integrated into other subjects (Angie, Kirby, Virginia). Kirby said, "We don't really teach science by itself." Although Sawyer and Carmen did not specifically mention doing so in response to this question, they spoke of it at other points during the interviews. The time estimates for teaching science ranged from 60 to 150 minutes a week. All teachers estimated on the high end, saying things like "best case scenario" (Sawyer) or "that might be pushing the envelope a little bit" (Virginia). When asked how this compares to the time required by the school system, all responded that there were no requirements by the school system for teaching science.

Among factors that contribute to the amount of time spent teaching science, time was the most common issue. Teachers talked about reading and math being a priority with schedules, then factoring in lunch and specials; not much time is left, especially when there are assemblies, pep rallies, or other factors. Teachers in Alabama have rest time and said that sometimes students need more time to rest. Carmen, the Tennessee teacher who teaches science in the mornings, stated that time for breakfast, parent meetings, school programs, children becoming ill, and teachers calling on the phone affect how much time is spent teaching science. Virginia, the teacher in the county system in Alabama stated that testing was a big factor for her. Two times every nine weeks she completes on-on-one testing with students. She spends about an hour per child with twenty students in her classroom each time she administers the test. Virginia's students also complete progress monitoring for DIBELS once a month. In addition, they complete a performance series assessment called Global Scholar for math.

When asked how they decide what to teach in science, co-researchers responded with using the standards (Angie, Carmen, Virginia), by seasons and/or holidays (Carmen, Kirby, Sawyer), and using kits (Angie, Sawyer). Angie gave several examples of STEM activities she implements and Kirby said the kindergarten teachers map it out together at the beginning of the year around letters that are being studied. Her example was when studying the letter "P" they learn about penguins.

When asked how they choose their method of delivery for the content, teachers gave a variety of responses. Angie said she used what she thought students would enjoy. She wants students to have fun and not even realize they are learning. Angie likes to see them utilize knowledge they don't even know they have (for example, when building a roller coaster students said they needed to make it taller in order to gain more speed). Virginia said she uses thematic units to teach science, incorporating videos. Sawyer explained that it depends on the makeup of her class and what they are able to handle. Carmen said she has to consider the amount of time she can devote to the lesson, so it could be a simple introduction using a video or a hands-on experience. Kirby said she uses either reading or writing, but mostly stories as a method of delivery.

When asked about the integration of science with other subjects, almost every co-researcher talked about incorporating it with reading. There was mention of incorporating it with math, but few examples were given. One example was building numbers with Legos (Angie) and another example was reading the book *How Many* that featured different snails and animals (Sawyer).

For the final question, co-researchers were asked if there was anything else they would like to share. Angie said there is just not enough time to do it all and that you have

to integrate science with everything. Kirby shared that she wished she had more time to do some things, but they just don't have the time. Carmen explained that her kindergarten team had good intentions for making science a priority, but nevertheless fell short. Sawyer said she has to remind herself that her students are five years old, and that they are going to make messes when they explore. For example, when she first started teaching she was worried about them spilling water and tried to be too controlling. Eventually she realized that she needed to just give them freedom to create and come up with things that she couldn't have taught them to do. Sawyer said if you "let them go" they create some amazing things. Virginia wanted it known that she was excited that she would attend AMSTI training in the summer. She feels that doing so may enable her to do a better job of teaching science. Virginia said that right now it is "hit or miss."

Journal Entry Data Combined

The goal of the journal entries was for co-researchers to record their daily science activities and their decisions regarding consideration and implementation of such activities. Co-researchers were to log entries daily. Angie remembered to log her entries each day. The other co-researchers forgot to log entries some days. Sawyer forgot one week. The researcher emailed a reminder. Virginia was out for a few days and had a substitute. There were some days Virginia forgot to record her journal entries. Kirby logged two entries in one day.

Table 25. Specific Dates That Co-Researchers Logged Journal Entry Data

Dates	Angie	Sawyer	Virginia	Kirby	Carmen
April 4, 2016	Yes	Yes	Yes		
April 5, 2016	Yes	Yes	Yes		
April 6, 2016	Yes	Yes	Yes		
April 7, 2016	Yes	Yes	Yes		
April 8, 2016	Yes	Yes	Yes		
April 11, 2016	Yes	Yes	Yes		
April 12, 2016	Yes		Yes		
April 13, 2016	Yes				
April 14, 2016	Yes		Yes		
April 18, 2016	Yes	Yes			
April 19, 2016	Yes	Yes			
April 20, 2016	Yes		Yes		
April 21, 2016	Yes	Yes			
April 22, 2016	Yes	Yes			
April 25, 2016	Yes	Yes	Yes	Yes	
April 26, 2016	Yes	Yes	Yes		
April 27, 2016	Yes	Yes	Yes	Yes	
April 28, 2016	Yes	Yes		Yes	
April 29, 2016	Yes	Yes			
May 2,2016	Yes	Yes		Yes	Yes
May 3,2016	Yes	Yes		Yes	Yes
May 4,2016	Yes	Yes	Yes	Yes	
May 5,2016	Yes	Yes	Yes	Yes	Yes
May 6,2016	Yes	Yes		Yes	
May 9,2016	Yes	Yes	Yes	Yes, Yes	Yes
May 10,2016	Yes	Yes		Yes	Yes
May 11,2016	Yes	Yes		Yes	Yes
May 12,2016	Yes	Yes		Yes	Yes
May 13,2016	Yes		Yes	Yes	
May 16,2016	Yes		Yes	Yes	Yes
May 17,2016	Yes			Yes	Yes
May 18,2016	Yes				
May 19,2016	Yes				

Note: Table presents specific dates that co-researchers logged journal entry data in Qualtrics online survey software. Note that Kirby and Carmen's collection dates began later than the other three because Tennessee teachers joined the study after Alabama teachers began collecting data.

The combined journal entry data is presented in the tables below. Table 26 combines co-researchers' data from the days science was taught. Note that Angie taught more frequently than the other co-researchers—25 of the 33 days for which she entered data. Virginia taught least often—2 of the 17 days for which she entered data. The researcher found it interesting that so many lessons were taught independently after co-researchers discussed the importance of integrating science with reading. Almost all of the lessons were planned, with minimal spontaneous interactions logged. Two co-researchers, Sawyer and Carmen, did talk about spontaneous interactions with students that occurred outside. These specific interactions came up during culminating interviews after journal entries were completed. Another point of interest to the researcher was that although Angie and Sawyer are both from AMSTI school systems, Angie used kits frequently for her lessons and Sawyer did not.

Table 26. Number of Days Taught and How They Were Taught

Question	Angie	Sawyer	Virginia	Kirby	Carmen
Science was taught	25/33 (76%)	18/24 (75%)	2/17 (12%)	7/16 (44%)	3/9 (33%)
Independent lesson	25/25 (100%)	17/18 (94%)	0/2 (0%)	1/7 (14%)	2/3 (67%)
Integrated with reading	0/0 (0%)	1/1 (100%)	2/2 (100%)	4/6 (67%)	1/1 (100%)
Planned	25/25 (100%)	17/18 (94%)	2/2 (100%)	6/7 (86%)	3/3 (100%)
Science standard	23/25 (92%)	12/18 (67%)	2/2 (100%)	7/7 (100%)	3/3 (100%)
Part of a kit	15/25 (60%)	0/18 (0%)	0/2 (0%)	1/7 (14%)	0/3 (0%)

Note: Table presents number of days taught and circumstances surrounding lesson. For example, Angie taught science 25 of 33 days for which she logged data. All

25 days were independent lessons and were planned. Twenty-three of 25 days were connected to state science standards and on 15 of 25 days the lesson was part of a kit.

Table 27 shows the factors that impacted teacher decisions on the days that science was not taught. This table demonstrates that "time for another subject" was the main factor. The subject that required more time was most often reading. On a few days that Angie said that cleaning up from math centers or participation in writing lessons took a long time and kept the class from experiencing science. Testing was the second ranking factor. Virginia was the only co-researcher for whom resources were a big issue. School functions included assemblies, pep rallies, school clubs, and awards ceremonies.

Table 27. Factors That Impacted Science Instruction

Factor (Primary and Secondary)	Angie	Sawyer	Virginia	Kirby	Carmen	Totals
School function	1	2	1	1	3	8
Testing	3	1	5	2	5	16
Time for another subject	5	6	11	6	3	31
Longer nap	2	2	1	0	1	6
No resources	0	0	7	0	1	8

Note: The number of days each factor impacted science instruction on days when science was not taught.

At the beginning of the culminating interview, each co-researcher was given their packet of data to review. The data was presented in charts and graphs. When the co-researcher closed the packet and looked at the researcher, the researcher asked, "What did

you notice while reviewing your data?" Table 28 below shows each co-researchers' initial response.

Table 28. What Co-Researchers Noticed about Journal Entries Data

What co-researchers said they noticed when they first viewed their journal entry data	
Angie	Science lessons revolved around kits and the standards.
Sawyer	Taught science more often than she thought she did and mostly independent lessons.
Virginia	Did not teach science as much as she thought.
Kirby	Had to fit science in somewhere else and didn't cover all the standards.
Carmen	Had to do science first thing in the morning in order to get it in.

Note: Co-researchers were given journal entry data at culminating interviews and shared what they noticed.

Culminating Interviews Combined

When asked to reflect on their journal entries and comment on what they noticed, Angie and Kirby mentioned standards, Virginia said she didn't teach science as often as she thought, and Sawyer said she taught it more often than she thought. Carmen talked about a breakfast program at her school for which the school received a grant that allows students to eat breakfast in the classrooms in the morning. Carmen explained that students are not technically supposed to be doing work, so she shows either science or social studies videos and they discuss or write about them. Angie mentioned that much of her teaching involved using kits.

Regarding what they took into consideration when planning science activities, co-researchers' responses included time, resources, and changes needed to make activities

grade-appropriate (Angie); how to incorporate science into reading lessons (Kirby, Virginia); making the activities engaging to keep students' attention (Sawyer, Carmen); stimulating students' brains (Carmen); and making teaching easier (Sawyer).

Angie said that students got the expected results from science lessons. Carmen said that only a couple lessons veered off course, but in a good way because it allowed her to revisit previous lessons, which tied everything together. Kirby said she mostly had question-related activities that went with the stories they were reading. Sawyer had taught most of her lessons previously and had already "trouble-shooted" some of the problem areas. She said that if students had trouble, she took them back to the carpet and redirected them. Virginia stated that she didn't do many science activities.

Regarding science activities that did not go as planned, responses included a new AMSTI kit called sunny sandbox, and students having a difficult time with simple tasks, like tearing tape (Angie). Carmen said students were taken out of the room for Response to Intervention and she was testing in her classroom, which meant she had to make a decision to forego science. Kirby, who said she mainly used question-related activities with reading, said there were no science activities that didn't work. Sawyer said that more time was needed than had been planned for science, so on some occasions the science lesson had to be continued the next day. Virginia said that fundraisers and rodeo week interfered with science time.

When asked about how the levels of engagement were during science, Angie and Sawyer both replied that their students were very engaged. Angie's students moved around (for example, doing a molecules activity). Sawyer thought engagement might be high because students don't spend as much time on science as with other subjects. Also,

every day it is something new, so they don't get bored or frustrated with science. Carmen thought it was good because it is first thing in the morning, but then realized that social studies are first thing in the morning on some days and they students are not as engaged, so it must be the hands-on experiments. Carmen said it's more fun to do "bubbly, fizzy things that might explode or ooze or goo." Kirby said students are more engaged with the hands-on stuff, more than questioning. Virginia said that they are pretty good, especially at the end of the year when they are able to sit more and do more.

When asked about factors that impact their decisions about when to engage students in science, co-researchers gave a variety of answers. Angie based her decisions on which AMSTI kits she would have so that resources would be available. She selected some activities, like the bubble stations, just for fun. The sunny sandbox activity was selected because a neighboring teacher had it and wanted Angie to do it with her class. Finally, Angie chose STEM activities because she loves them, and the children do too. When Angie didn't get to teach science, it was either because of a special activity (like writing for Mother's Day) or because it took a long time to set up the math games for centers. "A lot of days the math games have such a big clean up or prep that it's hard to do the prep for the math games and the prep for the science and get it all cleaned up and move on to the next one and get everything in."

Carmen said that factors included assemblies, parent visits to the classroom, interruptions from the office, a student needing one-on-one attention, and students being too wound up to participate in science activities. Sawyer says that more time was needed for a leadership event at her school called Wednesday Round Up(every other Wednesday). Another day was a club day. Sawyer's school has four club days a year

and they last about an hour in the afternoon. Virginia said she just needed more time to teach various subjects.

Sawyer commented that the schedule the teachers put in place at the beginning of the year was a factor. She said "the core subjects of reading and math had specific time allotments that we had to teach, so we filled them in first. Then we put in our lunch time and specials, and PE time, and play time, and then rest, and then there was about a 30 minute span at the end of the day."

Virginia talked about a lot of testing. She said they have Global Scholar for math, DIBELS for reading, and common assessments. The common assessments are done at four weeks and at nine weeks each grading period. It takes about an hour for each child and Virginia has 20 students—about a week each time it is administered. DIBELS takes about half a day and Global Scholar takes about 45 minutes total as the entire class takes it at once. Virginia shared that they were collecting data, but not doing anything with the data. She is currently reading a book that tells her how to use the data. Virginia has also met with a representative from Global Scholar about using the data from those assessments. She said the data does not help much for kindergarten students because they can't read, so they guess. She said, "We had a little girl that couldn't count to twenty and scored the second highest in kindergarten. She just guessed." Virginia feels that if we had conducted this research study earlier in the year, there would be more evidence of science instruction. Angie shared that they had to do benchmark testing as well, in reading and math. She said that it takes longer at the beginning of the year because so much technology is touch screen now, and students have to learn to manipulate the mouse. DIBELS is not a factor for Angie. Carmen and Sawyer said they

had to finish up some end of the year testing for report cards and science was not taught. Sawyer said they use a skills-based report card with 24 to 25 skills that had to be assessed one-on-one with each child. The kindergarten teachers at Sawyer's school create this assessment for reading and math each year based on the standards. It will include science once the new standards are available.

Kirby said that testing is not an issue for her. They do testing in phonics and math, but DIBELS testing is done during RtI time, so it does not impact science instruction. When Kirby thinks of something exciting to do in science, that's what impacts her decision. When asked about the lesson that was integrated with social studies, Kirby shared that they completed a unit on Tennessee. Students learned about the mockingbird from videos and learned about irises and parts of a flower. Kirby said students had to color a picture and make it look like a real iris. Students also talked about the stem and leaves and other parts.

Co-researchers talked about integrating science with reading. Carmen's class was one example of incorporating science into reading lessons. When they were studying butterflies in a science lesson and they also read a story about butterflies and watched a Discovery Education video, a Brain Pop video, and a Magic School Bus video on the topic. Sawyer talked about studying how things in nature are used to make new things. The class read *The Little Red Hen* and discussed how the hen grew the wheat and cut the wheat and turned the wheat into flour. They also read a book called *Bread Talks* and discussed different kinds of breads and bakeries, what people do with bread, and who makes it.

According to the co-researchers, most of the science activities went as planned. When Sawyer read and discussed the part in the book about the hen sowing the seeds and explained what it meant, her students related that to their plants lessons, making spontaneous connections. When asked about the spontaneous lesson mentioned in her journal entries, Sawyer talked about students pulling flowers out of the ground when they were outside playing and showing her the roots, stems, petals, and leaves, which they had learned about in a previous lesson. She that for weeks afterward said students were able to point them out independently, and this did not happen prior to the plant lesson. Kirby said she could not remember which lesson she identified as a spontaneous lesson, but if she had to guess, she would say transportation. She also taught a lesson using a kit—the volcano that was created using clay and paint.

Kirby talked about the field trip to the hands-on science center. Her students went into a room and made shadows, watched an animal show, and talked to one another across the room using big tubes. According to Kirby her favorite thing to teach was animals and her least favorite was transportation. She said that the children already know a lot about transportation, so it is boring to teach. Angie's favorite thing to teach is anything that will get the kids excited and her least favorite are things she has to teach in order to get to something else. Those days are less engaging. Angie says that when students are participating in activities she actually has fewer class management problems. Angie stated that teachers are afraid there will be management problems, when in fact they actually occur when students are expected to sit in their seats and work. Carmen shared that the butterfly life cycle is one of her favorite things to teach. She loves the kids' reactions when they run in to see what happened with the butterflies overnight.

Carmen enjoyed their excitement when they put gummy bears in various solutions to see how they dissolved and students came in eager to see what happened. She stated, "If I could teach everything through a science lesson, I probably would."

When asked about how co-researchers' participation in the study impacted their science instruction, if at all, Angie said she now has an awareness of how much AMSTI kits play into what students are able to do in science. She enjoys using the kits because all the resources are there and ready to go. Virginia shared that resources are a problem for her, stating that her school has nothing for science. She hopes that will be different next year, as she trained with AMSTI this summer. Carmen said she was more focused on really trying to get science in, mostly because it was the end of the year, when they are "wrapping a lot of things up." Last year Carmen set a goal to do more science this year because she and her team felt that they were not doing enough science and social studies. Carmen feels that she did better this year, but still wants to do more. When asked what this would look like, Carmen explained that she would like to start the week introducing a science lesson, maybe with a story or video, and build on it, maybe through a writing activity. Next, students would complete some discovery experiences and then have a Fun Friday in which a large experiment would be done to test and apply what was learned through the week. Carmen and the researcher discussed the possibility of doing the opposite some weeks—exploring first as an introduction to elicit curiosity, then building on that curiosity. Carmen liked this idea. Kirby said that the research study was done for just a short time, but she feels like she paid more attention to what the science standards are. Because they don't really have a designated science time, she doesn't pull the standards out a lot. Kirby shared that doing this study would impact her instruction next

year; she would focus on it because she would be reporting which standards she taught. Sawyer said she now realizes that even when she thinks there is not enough time to teach science, there really is time. She added that seeing how much her students love to interact and participate in science made her feel guilty that she hadn't made it a higher priority before this study. Virginia said she thought about it every day when she sat down to fill out her survey. Each day she had to report that she didn't get to teach science.

According to Sawyer, if she taught something that was not a state science standard, other standards fit the activity (such as reading or math standards). When asked about the six lessons that were not state standards, Sawyer named Mother's Day and family-related activities, and summer safety. These lessons don't connect with state standards in any way, but "because our science is not technically required by minutes, we thought it's great to follow the theme and the holidays."

When asked about anything else they wanted to share, Angie said she taught science more than she thought she would. However, she wishes there was more integration. Carmen wants to do more science. She shared experiences walking around outside with the children and finding bird eggs, feathers, and sticks that looked like dinosaur bones, which sparked discussions and mini science lessons. The more Carmen talked the more she realized she was doing things she hadn't considered science lessons. Sawyer really enjoyed being part of the study. She liked the reflection piece, and the affirmation that she taught more science than she thought she did. Virginia was amazed at how often she did not teach science. She knew day-to-day as she recorded her science

instruction in her journal that she had not done it, but seeing the data compiled really made it apparent that she wasn't teaching science.

Each co-researcher's data revealed something of interest. Angie had multiple examples of ways to integrate science with other subjects. She also taught more lessons that were not related to science standards, compared to the other co-researchers. Angie's data also revealed that she often uses AMSTI kits in her teaching, and implements a variety of STEM lessons. Although Sawyer teaches in the same school system, she did not teach from the AMSTI kits and she taught different topics than Angie's. This tells the researcher that the system probably does not have a pacing guide for the kindergarten teachers, or that they vary the topic times to account for kit rotations. Some of what Sawyer considered teaching science may have been considered as such because of the time of day at which it was taught as opposed to the content. Sawyer talked about students bringing her objects on the playground and applying their science learning. She specifically shared how they brought her flowers and pointed out all the parts. Virginia, also in Alabama, talked about testing more than anyone else. Her students are subjected to many tests several times a year. Virginia did not give many examples of teaching science in the classroom, but was very excited to be going to AMSTI training this summer. Currently Virginia has no resources available for teaching science.

In Tennessee, Kirby talked about selecting science lessons based on the letter of the alphabet they were studying that week in addition to seasons and holidays that other co-researchers mentioned. She did not give many examples of teaching science in the classroom. Kirby appeared to be conscientious about how students would perform on state science tests when they are tested in third grade, which is the first grade for state

standardized testing. Carmen talked a lot about spontaneous mini-lessons, and although at first she did not recognize how often these informal conversations happen when she takes her students outside, she is aware now. Carmen exposed students to academic language, like meconium and oviparous. She talked in detail about her plans to improve science instruction. Carmen stated several times that she loves science.

There were a few commonalities among co-researchers' responses. The researcher noticed that none of them declared at a young age that they wanted to be a teacher. Co-researchers either had a different major in college (law, nursing, psychology), or didn't know for sure what they wanted to do, but ended up working with children (babysitting, daycare), which lead them to teaching.

All of the co-researchers talked about how much their students enjoy science. Students particularly love hands-on activities. Two co-researchers mentioned that students' behavior is better when they are engaged in science. Four of five co-researchers specifically mentioned integrating science into reading and math in order to fit it into the schedule. The word *integrate* was used several times. Only one co-researcher did not use the term, alluding to integrating one lesson with reading.

Testing was mentioned or logged in the journal template by all five co-researchers. Virginia talked about it considerably more than the others. In describing how they determined when to teach science, all five talked about reading and math being scheduled first, followed by lunch and specials. Recess was also a consideration, as well as PE. Whatever time was left in the day was devoted to science or social studies. In the Alabama city system rest time was also given priority over science and social studies.

Chapter Summary

In chapter four the researcher shared analysis of individual cases, each co-researcher being a case, and cross-case analysis of co-researchers combining the initial interviews, journal entries, and culminating interviews.

Regarding individual cases, Angie spoke often of using both AMSTI and STEM kits in her classroom. She enjoyed their convenience. She also taught outside of the standards more than the other co-researchers. Sawyer works in the same system as Angie, but does not use kits. More of her lessons are planned around holidays and seasons. Virginia spoke most about how testing impacts her instruction, and the lack of resources. Kirby cited few science experiences and explained that science instruction is dependent on the alphabet letter of the week. Carmen is the only teacher who teaches science first thing in the morning. She also mentioned spontaneous interactions with students that occur when they are outside.

Some commonalities were revealed in cross-case analysis. The researcher found it interesting that none of the co-researchers aspired to be a teacher early in their lives, that none of the co-researchers' school systems had requirements for teaching science, and that science and social studies are considered last when creating the daily schedule at the beginning of the year, behind reading, math, PE, lunch, specials, and recess (and nap time in Alabama schools). All co-researchers talked about the need to integrate science with other subjects, particularly reading, in order to get it taught. Regarding factors that impact decisions about when to teach science, more time needed for another subject ranked considerably higher than the other factors, followed by testing.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

Introduction

Students enter kindergarten as natural-born scientists (NRC, 2012; Mantzicopoulos, Patrick, & Samarapungavan, 2008), curious about the world around them. Young children enjoy science (Gerde, Schachter, & Wasik, 2013), but positive attitudes towards science decline in middle and high school (Spektor-Levy, Baruch, & Mevarech, 2014). Although implementing science in kindergarten has the ability to support development in other domains in meaningful ways (Gerde, Schachter, & Wasik, 2013), science plays only a minor role in kindergarten (Henrichs & Leseman, 2014). There are many reasons for this according to the literature. The purpose of this study was to gain insight into teachers' thinking as they decide when and how to engage their students in science, in order to better understand why student enjoyment of science fades in early grades; to contribute teachers' voices to the existing literature on teaching science in the early grades; and to investigate how teachers' science teaching methods align with current research regarding how students learn best.

The key research question was "What are the factors that impact teachers' decisions about when to engage the natural curiosities of their students?" The supporting questions included: 1. What factors impact teacher decisions about when to teach science? 2. Under what conditions do teachers engage students' natural curiosities in science? 3. How do teachers describe engagement in their classrooms?

Discussion

In analyzing cases, some findings were specific to individual co-researchers. Angie spoke often of using kits in her classroom, both AMSTI and STEM kits. She said she enjoys the convenience of using them. According to Sackes (2012), teachers who have access to manipulatives and nature areas to teach science are more motivated to teach science. Angie also taught outside of the standards more than the other co-researchers.

Sawyer works in the same system as Angie, but did not use kits during the time of the study. Sawyer's lessons are planned more around holidays and seasons. She gave specific examples of activities for Mother's Day, Martin Luther King, Jr. holiday, and summer safety that were conducted during social science time. This coincides with the literature that states that science is presented as isolated instruction, mostly in context of seasons or cultural events. There is "no evidence of conceptual coherence or continuity across science topics" (Patrick, et al., 2009, p. 183). Sawyer talked about spontaneous interactions that occurred with students outside on the playground.

Virginia spoke more than the other co-researchers about the impact of testing on her instruction. Griffith and Scharmann (2008) said that less time is spent teaching science because math and literacy are taught the majority of the day, due to the standardized testing mandated by No Child Left Behind. Virginia also said she did not have resources available.

Kirby shared few science experiences, but explained that science instruction is dependent on the letter of the week. One example she gave was studying penguins the

week of letter "P." The activities students experienced included watching a model volcano erupt and coloring a picture of an iris to look like the real flower.

Carmen is the only teacher who teaches science first thing in the morning. She said because students are eating breakfast, she is not allowed to teach anything important. Carmen also spoke about spontaneous interactions that occur with students when they are outside.

With regard to cross-case analysis, some commonalities were seen. The researcher found it interesting that none of the co-researchers aspired to be a teacher early on in their lives. They were all led to the profession after trying to do something else, or after being undecided about what they should do. None of the co-researchers' school systems had requirements for teaching science. Science and social studies are last to be considered when the daily schedule is created at the beginning of the year, behind reading, math, PE, lunch, specials, recess, and (in Alabama schools) nap time. All co-researchers talked about the need to integrate science with other subjects, particularly reading, in order to get it taught. Mantzicopoulos, Patrick, & Samarapungavan (2008; 2009) said there is a big push to teach science through reading. In considering factors that impact decisions about when to teach science, more time being needed for another subject ranked considerably higher than the other factors; usually co-researchers were teaching reading. Other subjects that took precedence over science included writing and math. Testing was the second highest factor that impacted teacher decisions about when to teach science. Teachers feel more pressure to "teach language and literacy" (Sackes, Trundle, Bell, & O'Connell, 2011, p. 230) to help prepare students for testing (Griffith & Scharmann, 2008).

Based on the literature review and examination of the data collected from all co-researchers combined, the researcher came to several conclusions:

1. Science is not taught often enough in kindergarten.
2. There are many factors that affect teachers' decisions about when to teach science.
3. Student engagement is high during science.
4. Students' natural curiosities are not engaged often enough during science lessons.
5. In today's world of accountability, science needs to be integrated with other subjects in order to be taught.

The researcher's claim that science is not taught often enough in kindergarten is based on NSTA's recommendation that every child at every grade level receive inquiry science instruction every day. According to the literature and this study, this does not happen. During initial interviews some co-researchers answered the question about how often they teach science by stating that they teach science up to 150 minutes per week. However, this did not happen during our data collection time. Co-researchers did make comments such as "if I am lucky" or "best case scenario" and even "that might be pushing the envelope," showing that they recognize that they are not teaching science as often as they should. Review of journal entries data showed that only two of the five co-researchers taught science more than fifty percent of the days for which they recorded journal data.

With regard to claim number two, many factors impacted teacher decisions about when to teach science. Although other (tested) subjects requiring more time, testing, and

in one case lack of materials were all major factors in our study, it appears that most things take priority over teaching science, including extended nap time in some cases.

All co-researchers shared how much their students really enjoy science. One co-researcher said she felt guilty for not providing more experiences in science after seeing and remembering how much her students really enjoy it. With regard to student engagement, three of the five co-researchers described their students' engagement during science as "very high." One claimed that managing behavior is easier during science than other subjects because students are engaged.

Although many examples were given of high engagement during science instruction—students building roller coasters, making bridges, and experiencing the life cycle of the butterfly, as well as other engaging experiences—there were also examples of students participating in activities that do not engage their natural curiosities. Reading stories that are not tied to inquiry experiences and counting it as science because the book had bugs in it should not constitute science instruction for the day. The same applies to watching videos, or watching the teacher (with no participation or follow-up) demonstrate a concept, or coloring a picture of something science-related, like a flower. Children should be "doing" science in order to understand science, not just observing it. Two co-researchers talked about students bringing items to them while outside, asking questions or sharing what they already knew about the object in order to confirm their knowledge. These experiences are the epitome of engaging students' natural curiosities because students are initiating science instruction regarding something they are interested in learning more about. Co-researchers did not initially think of this as science

instruction as these interactions were not even recorded in their journals, but came up during interviews.

With today's curriculum demands, teachers really do not have time to teach science every day if it is not frequently integrated with another subject. Many unplanned occurrences take up time during a teacher's day—class interruptions and students who need individual attention, to name a couple that came up during interviews with co-researchers. There are times in which science will be a stand-alone subject for the day, but when we can integrate it with other subjects we show students how things are interrelated. When we read books to students about butterflies because our letter of the week is "B," we teach them nothing about butterflies themselves.

Reflection on Data Collection

After reflection on the journal entries, it is the researcher's opinion that a few changes should have been made to the journal template. If a lesson carries over to the next day, that lesson should be counted on both days because time was given each day to work on the lesson. This came up in one culminating interview and the co-researcher stated that she counted the lesson for one day. Because the journal entries show that two days were skipped in data collection, the co-researcher may not have counted science for that day because it was a continuation from the day before. In terms of integrating science with another subject, the journal template should have a place to mark whether the standard taught was a reading or math standard, instead of just asking what subject science was integrated with that day. The assumption is that the lesson is standards-related, just not a science standard. In addition, some lessons (such as those about

Mother's Day and summer safety) were called science lessons because they were taught during science time, when actually they are not a science standard or science concept.

Implications for Future Research

Ideas for future research include changing the current study or branching into other areas of study. One example of changing the current study could include expanding the data collection period to a full school year instead of eight weeks at the end of the year, identifying a larger number of co-researchers, and including more systems in more states. Incorporating focus groups throughout the study could be another way to change the current study. Focus groups would provide insight into decisions made throughout the year, so co-researchers are not trying to recall information and answer questions posed at the end of the study during culminating interviews. It would be interesting to see how co-researchers interact. Co-researchers could learn from their peers and alter the way they implement science in the classroom if focus groups were used throughout the study, altering the data.

To branch off from the current study, the researcher would like to explore the idea of spontaneous interactions, studying an early learning STEM school, and comparing the impact of AMSTI training on science instruction.

With regard to spontaneous interactions, the researcher would need to consider how best to study these interactions. The researcher believes that bringing the idea of spontaneous interactions to the attention of the co-researchers during the study would impact the frequency of organic interactions. Classroom observations would be needed.

Another concept for further study could include STEM schools. One co-researcher, Angie, left her teaching position at the school she has taught in her entire

career to teach in a special kindergarten-through-first-grade STEM school. The school started in the 2016-2017 school year and has plans to add another grade level each year. It would be interesting to see how this transfer impacts Angie's science instruction, and to follow the progress of the school's STEM concept. It is one of only a few STEM schools for early learners in the nation.

Researching the use of AMSTI kits would be another potential area of study. Virginia, who has been teaching for 26 years, attended AMSTI training for the first time the summer of 2016. It would be an interesting case study to investigate how this training, which includes obtaining many resources, impacts Virginia's science instruction.

Recommendations for Teachers

After conducting the study, the researcher has several recommendations for teachers to improve science instruction in kindergarten. These include (1) elevating the importance of science in the classroom, (2) correctly integrating science into classroom instruction, and (3) recognizing and acting on opportunities for spontaneous instruction.

Scheduling science every day and finding time to implement it as planned sends a message to students that science is important. Patrick, et al. (2009) says the amount of time spent on a task communicates its value. Instead of thinking science will only be taught if there is time, teachers should consider all the possibilities for incorporating science into the curriculum in reading, math, and writing. Students should know it is as important as reading and math.

Teachers should ensure that the quality of science instruction is high. Reading about science-related topics is not "doing" science. Students gain information, but they

learn nothing about the process of science. Students need to experiment to understand how science works. Children develop an understanding of science and find an interest in science through active engagement (Mantzicopoulos, Patrick, & Samarapungavan, 2008). Teachers should integrate reading and writing about science topics with inquiry activities. This approach "establishes a cohesive context in which children can develop skills and knowledge important for both literacy and science" (Patrick, Mantzicopoulos, & Samarapungavan, 2009).

Science instruction does not always have to be whole-group instruction and planned. Teachers can take advantage of spontaneous interactions with students, whether indoors or outdoors. Spektor-Levy, Baruch, & Mevarech (2013) maintain that scientific curiosity leads to scientific knowledge. Engaging students' curiosities by probing them with questions about found objects or ways to try new processes helps students better understand their world. Spektor-Levy, et al. (2013) described:

> specific ways to foster scientific curiosity among young children … (1) being attentive and responsive; (2) demonstrating and modeling excitement and curiosity; (3) encouraging questioning; (4) arousing children's attention; (5) facilitating and participating in inquiry; (6) utilizing stories, games and pictures; (7) exposing and providing accessibility to stimuli; and (8) using multisensory teaching methods.

Recommendations for Administrators

Administrators can support teachers to improve science instruction. Recommendations for administrators include recognizing the importance of science and ensuring its place in the curriculum by making it a daily requirement. NSTA (2002)

states, “inquiry science must be a basic in the daily curriculum of every elementary student at every grade level.” Administrators should ensure that science instruction is appropriate and not superficial by monitoring lesson plans and making classroom visits. This means teachers and administrators may need to participate in professional development opportunities on proper science instruction. Participation “might contribute to the increase in the frequency of science teaching in kindergarten” (Sackes, 2012, p. 180).

Although only one co-researcher in the study shared information about a lack of resources in her school, the co-researcher who taught science most often spoke of using kits frequently. She said the kits contained all the resources she needed, making teaching science convenient and less costly. Administrators should make sure that resources are available to teachers because access to science materials “encourage[s] teachers to teach specific science content” (Sackes, 2012, p. 180).

Conclusion

Students enter kindergarten having spent the last few years making observations through using their senses. They put everything in their mouths during infancy, touch almost everything they can as toddlers, and ask many questions from a young age. They are naturally curious about the world around them. Young children perform science experiments all the time. They drop objects to see what will happen, hit things to see how they sound, and even behave in certain ways to see what kind of reaction they get from others. They enter kindergarten with a natural ability to do science. But instead of building on this natural ability and using it as a vehicle to deliver concepts that do not come as naturally (such as reading and math), children are often seated at tables and

expected to learn letter sounds, how to write letters, and math concepts, often taught in isolation. Alternatively, educators could offer science experiences and connect those experiences to other subjects.

Students enter kindergarten with basic knowledge of science, but the role of the kindergarten teacher is imperative in laying a solid foundation for students' understanding of science. Engaging students' natural curiosities in meaningful activities helps them gain content knowledge and understand science processes. Educators need to make time for science in the early grades. Student abilities are present when they enter kindergarten. Much learning is lost when we place science on hold until it is tested in third grade.

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APPENDICES

APPENDIX A

PROJECT TIMELINE

The timeline that occurred included the following:

January-February, 2016: Obtained permissions from school systems in Alabama and Tennessee

February 29-March 1, 2016: Identified Alabama city system co-researchers through initial meetings, Angie and Sawyer

March 10, 2016: Initial meeting with Alabama county system co-researcher, Virginia

February-March, 2016: Obtained permissions from school administrators in Alabama

March 10, 2016: First interviews with co-researchers in Alabama—Angie, Sawyer, and Virginia

March 22, 2016: Transcripts from first interviews approved by Alabama co-researchers

March 26, 2016: Created journal template and emailed for feedback from co-researchers

March 28-April 1, 2016: Journal template trial period; obtained feedback and made changes to template; added comments section

April 2, 2016: Sent online template to co-researchers in Alabama

April 4, 2016: Began journal entry data collection for Alabama teachers

April 4, 2016: Initial contact with Kirby via email

April 22, 2016: First interview with Kirby

April 25, 2016: Kirby began journal entry data collection

April 30, 2016: Received interview questions from Carmen via email

May 2, 2016: Carmen began journal entry data collection

May 19, 2016: Journal entry data collection last day

June 2, 2016: Culminating interviews with Angie, Sawyer, and Virginia

June 8, 2016: Culminating interviews with Kirby and Carmen

June 17, 2016: transcripts sent for approval

June 19, 2016: all transcripts approved

APPENDIX B

AMSTI

What is AMSTI?

The Alabama Math, Science, and Technology Initiative, commonly referred to as AMSTI, is the Alabama Department of Education's initiative to improve math and science education across the state.

AMSTI provides students with well-trained teachers and the equipment, materials, and resources needed for hands-on, activity-based math and science education.

Also, teachers are supported and mentored by AMSTI site math and science specialists as they implement the training they received during the summer.

What is an AMSTI School?

An AMSTI school is a school that receives all of the benefits of the initiative including:

- extensive professional development
- equipment, supplies, and materials (including refurbishment)
- In-school support by math and science specialists at *no cost to the school!*

ALABAMA MATH, SCIENCE, AND TECHNOLOGY INITIATIVE

AMSTI unites students, teachers, administrators, parents, and businesses to benefit the community.

AMSTI

For more information, contact:

Mr. Steve Ricks, Director
Alabama Math, Science, and Technology Initiative
Alabama Department of Education
50 North Ripley Street
P.O. Box 302101-2101
(334) 353-9151 • e-mail: questions@amsti.org
Web site: www.amsti.org

Joseph B. Morton, State Superintendent of Education June 2008

No person shall be denied employment, be excluded from participation in, be denied the benefits of, or be subjected to discrimination in any program or activity on the basis of disability, sex, race, religion, national origin, color, or age. Ref: Sec 1983, Civil Rights Act; 42 U.S.C.; Title VI and VII, Civil Rights Act of 1964; Rehabilitation Act of 1973, Sec. 504; Age Discrimination in Employment Act; Equal Pay Act of 1963; Title IX Coordinator, P.O. Box 302101, Montgomery, Alabama 36130-2101 or call (334) 242-8644.

AMSTI

AMSTI

Alabama Department of Education
50 North Ripley Street
P.O. Box 302101
Montgomery, AL 36130-2101

www.amsti.org

ALABAMA MATH, SCIENCE, AND TECHNOLOGY INITIATIVE

How does a school join AMSTI?

Schools are selected through a competitive application process. Math and science teachers and administrators in AMSTI schools agree to attend ten days of summer institute for two consecutive summers and to participate in additional professional development during the school year.

What are the benefits of AMSTI?

- Increases teacher content knowledge
- Increases student interest and participation in math and science
- Improves student understanding of abstract concepts
- Improves student behavior
- Encourages students to remain on-task
- Provides a method students prefer over traditional teaching methods

How does AMSTI affect test scores?

In **every** case, on **every** standardized test given by the Alabama Department of Education, AMSTI schools outperformed matched Non-AMSTI schools – often dramatically as confirmed by three consecutive years of external evaluations.

"We will expand AMSTI to every school in the state, revolutionizing our students' math and science education and preparing them for the future."
– Governor Bob Riley

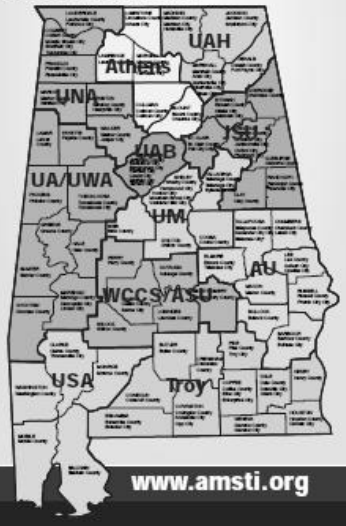
What is Alabama Science in Motion (ASIM)?

Alabama Science in Motion (ASIM) is the Grades 9-12 science component of AMSTI. The program serves teachers and students of biology, chemistry, and physics. Much of the equipment provided is state-of-the-art and not usually available to high schools. AMSTI-ASIM delivers the technology and materials directly to schools due to the value and sensitivity of the equipment. Specialists provide teacher training and classroom support in using the labs and equipment.

What is a Regional AMSTI Site?

The Alabama Department of Education funds regional resource sites to support AMSTI in local schools. These local sites conduct the summer training institutes, provide math and science specialists to work with AMSTI teachers throughout the year, and operate the material centers. The material centers ensure that all math and science kits are delivered to the school doors ready for use by the teachers and students.

AMSTI Sites by Region



www.amsti.org

APPENDIX C

EXEMPT DESIGNATION LETTER

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

EXEMPT APPROVAL NOTICE

2/19/2016

Investigator(s): Frances Hamilton & Rick Vanosdall
Department: College of Education
Investigator(s) Email: fah2f@mtmail.mtsu.edu
Protocol Title: "Factors That Impact Kindergarten Teachers' Decisions About When to Engage Their Students' Natural Curiosities in Science "
Protocol ID: 16-1128

Dear Investigator(s),

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above and this study has been designated to be EXEMPT.. The exemption is pursuant to 45 CFR 46.101(b) **(2) Educational Tests, Surveys, Interviews, or Observations**

The following changes to this protocol must be reported prior to implementation:

- Addition of new subject population or exclusion of currently approved demographics
- Addition/removal of investigators
- Addition of new procedures
- Other changes that may make this study to be no longer be considered exempt

The following changes do not have to be reported:

- Editorial/administrative revisions to the consent of other study documents
- Changes to the number of subjects from the original proposal

All research materials must be retained by the PI or the faculty advisor (if the PI is a student) for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

NOTE: All necessary forms can be obtained from www.mtsu.edu/irb.

APPENDIX D

FIRST INTERVIEW QUESTIONS

First Interview Questions (once the co-researchers have been identified and prior to collecting data through journals)

Introduction

1. Purpose: I asked to talk with you because in our previous conversations, some of your comments indicated you were interested in examining factors that influence when you engage your students natural curiosities in science.
2. Overview of questions: This is a conversation with questions to guide it. This interview is purely voluntary, and nothing in my write up will identify you as a participant or link you to any specific comment. I have a set of ten (10) questions. If at any point you would like to skip a question, or stop the interview, just say pass or you would prefer to stop the interview. However, as you answer the questions feel free to add any additional comments or clarifying statements you wish.
3. May I record our conversation? _____
4. Questions:

A. How many years have you been in education?
B. How did you decide to become a teacher?
C. What does student engagement look like in your classroom?
D. How much time do you spend weekly teaching science?
E. How does this compare to the time recommended/required by your school system?
F. What factors contribute to the amount of time spent teaching science (be as specific as possible)?
G. How do you decide what to teach in science?
H. How do you decide the method of delivery for the content?
I. When are times you have integrated science with other subjects?
J. What else would you like to share about teaching science in your classroom?

Thank you for spending time with me today. Once initial interviews are complete, you will receive transcripts in which you may make additions, clarifications, or deletions of information. Soon you will receive a data collection document that will guide journal entries. Thank you again for your time.

APPENDIX E

JOURNAL TEMPLATE

Dissertation Journal Template/Checklist Teacher's Name _____
Today's Date (mm/dd/yy)_____

1. Science was taught today Yes No (skip to # 9)
2. If yes, it was an independent lesson (skip to #4) integrated with another subject
3. If integrated, what subjects were also taught Reading Math Social Studies Other _____
4. This lesson was planned happened spontaneously, initiated → by teacher by student
5. This lesson is a state science standard is NOT a state science standard
6. This lesson is part of a kit NOT part of a kit AMSTI Other _____
7. What was the topic _____
8. My feelings on this topic Most favorite 10 9 8 7 6 5 4 3 2 1 Least favorite (to teach)
9. If science was NOT taught today, what were the factors, or the factor, that impacted that decision

(Primary factor =1, Secondary factor, if applicable =2)

a. _____There was an assembly/pep rally
b. _____We were testing in reading math other _____
c. _____ More time was needed for reading math other _____
d. _____Students were too tired/nap time was needed

e. _____Resources were not available We needed _____

End of week reflection:

_____
_____
_____
_____
_____
_____
_____
_____

APPENDIX F

CULMINATING INTERVIEW QUESTIONS

Culminating Interview Questions (These occur once journal entry data collection is completed)

This is a conversation with questions to guide it. This interview is purely voluntary, and nothing in my write up will identify you as a participant or link you to any specific comment. I have a set of seven (7) questions. If at any point you would like to skip a question, or stop the interview, just say pass or you would prefer to stop the interview. However, as you answer the questions feel free to add any additional comments or clarifying statements you wish.

May I record our conversation? _____

1. In reflecting on your journal entries, what did you notice?
2. What did you take into consideration when planning science activities?
3. In what ways did your science activities go as planned?
4. In what ways did your science activities not go as planned?
5. How were the levels of engagement during science activities?
6. What were some of the factors that impacted your decisions on when to engage your students in science?
7. How has your participation in this study impacted your science instruction?

Thank you for your time today and for your participation in this study. Your cooperation is greatly appreciated.