UTILIZING AN EARLY CHILDHOOD SCIENCE CURRICULUM: FACTORS INFLUENCING IMPLEMENTATION AND HOW VARIATIONS AFFECT STUDENTS' SKILLS AND ATTITUDES

by

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Utilizing an Early Childhood Science Curriculum: Factors Influencing Implementation and How Variations Affect Students’ Skills and Attitudes

Thesis directed by Associate Professor Michael P. Marlow.

ABSTRACT

Early childhood is a ripe time for students to begin learning science, but due to certain constraints, this instruction is not happening as frequently as it should. This mixed-methods, multiple case study examined how two teachers implemented an early childhood science curriculum, the Young Scientist Series. The teacher participants were two early childhood teachers, and student participants were three groups of 4 to 6-year-olds they taught for eight weeks. The study investigated how the teachers’ pedagogical decisions affected their students’ process skills acquisition and attitudes toward science. It specifically examined how the teachers made choices about what to include, change, omit, and add to the lessons. It also analyzed the levels of inquiry present in the lessons (structured, guided, or open). Quantitative data were collected from the teachers through questionnaires, checklists, and observations, and qualitative data were gathered through interviews. Student data were quantitative. Their science process skills and attitudes towards science were assessed with two age-appropriate instruments, the Science Learning Assessment and the Puppet Interview Scale for Competence in and Enjoyment of Science. Findings showed that the students of the teacher who followed the curriculum more closely and employed more structured inquiry did not grow in their process skills, and their attitudes followed a normal distribution. The students of the teacher who followed the curriculum more leniently and employed more guided inquiry
grew in their process skills in significant ways. Their attitudes followed a negatively skewed distribution, reflecting that a majority of the students scored very highly on the attitude assessment.

*Keywords:* early childhood, science, curriculum, inquiry, process skills, attitudes

The form and content of this abstract are approved. I recommend its publication.

Approved: Michael P. Marlow
DEDICATION

I dedicate this work to William L. Goodwin, a man whose intelligence, humor, love of learning, support, kindness, and perseverance have continued to inspire me to achieve my goals.
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CHAPTER
I. INTRODUCTION

Introduction

The subject of science has received more attention in the educational arena during the past decade. As a result of the Elementary and Secondary Education Act, commonly known as No Child Left Behind (No Child Left Behind Act, 2001), science has generated interest in educators of even the youngest children. No Child Left Behind (NCLB) requires that states administer a science test in each of three grades (3-5, 6-9, 10-12), a requirement that began in 2007-2008 (“New Science Software,” 2007). NCLB has evolved since its initial implementation, and the federal government has granted some states waivers from NCLB requirements. Despite these changes, the federal government still requires states to account for their students’ learning through high-stakes assessments. Since younger children are being tested on their science knowledge, concerns about science proficiency have surfaced (Penuel, Fishman, Gallagher, Korbak, & Lopez-Prado, 2009).

President Barack Obama has stressed the importance of science education, not only in his 2008 presidential campaign ("A World Class Education," 2008) but in his 2011 State of the Union Address. In that Address, he advocated for more scientific innovations in our society ("State of the Union 2011," 2011). He also expressed concern that the quality of our math and science instruction lags behind many other nations. On July 18, 2011, President Obama announced four major commitments to education. One of them was termed the “Educate to Innovate” campaign, created to accomplish the following:
Improve the participation and performance of America’s students in science, technology, engineering, and mathematics (STEM) and includes efforts from the federal government and from leading companies, foundations, non-profits, and science and engineering societies to work with young people across America to excel in science and math” (“Education,” 2011).

As a result of these political and societal pressures, educators of all levels are beginning to reexamine science education. Rowena Douglas, the past program director for K-8 science at the National Science Foundation, acknowledged that interest in science was growing even in the preschool community (Jacobson, 2002). This renewed interest in science makes the topic of early childhood science curriculum a timely one.

**Importance of Early Childhood Science**

Children’s foundations for learning begin in early childhood, and the subject of science is no exception. Research has shown that the foundation for educational opportunities in science can help promote children’s learning in the subject (Saracho & Spodek, 2008). During the preschool years, children begin to construct science concepts of more complexity (Lind, 1998). Critical spans for knowledge attainment in young children occur between the ages of four and six, and for some subjects this critical window closes early (Begley & Hager, 1996). According to Eshach and Fried (2005), science is one of those subjects.

One of the most important reasons for including science in early childhood education is because science taps into children’s natural curiosity (Eshach, 2006; Eshach & Fried, 2005; French, 2004; Rillero, 2005; Worth & Grollman, 2003). Children are also more capable of reasoning in scientific ways than previously thought (Eshach & Fried,
2005), and are able to create theories about the world and how it works (Conezio & French, 2002). These skills and ways of thinking are important to learning throughout life (Worth & Grollman, 2003).

**The Problem**

Despite the importance of starting science instruction early (Brenneman & Louro, 2008; Kallery, Psillos, & Tselves, 2009; Tsunghui, 2006; Yoon & Onchwari, 2006), many young children are not receiving science instruction (Chaille & Britain, 2003; Ginsburg & Golbeck, 2004). The reasons are many. One of the most important reasons is that early childhood teachers do not feel equipped to teach science (Friedl & Koontz, 2005; Watters, Diezmann, Grieshaber, & Davis, 2001). Many feel they lack the content knowledge needed to teach science (Forbes & Davis, 2008; Gilbert, 2009; Kallery, 2004; Kallery et al., 2009; Lewthwaite & Fisher, 2005; “Start Science Sooner,” 2010). In Gilbert’s (2009) study, approximately 60% of the participants felt uncomfortable with science content. Even though early childhood teachers have informal science knowledge acquired through their hobbies, interests, and classes, they do not realize this type of knowledge can enable them to teach science (Fleer, as cited in Fleer, 2009). This insecurity makes them hesitant to include science in their schedules.

Another factor impeding early childhood science instruction is time (Burgess, Robertson, & Patterson, 2010; Penuel, Fishman, Gallagher, Korbak, & Lopez-Prado, 2009). Teachers often feel that they do not have the time needed to include science in their schedules (Henning & King, 2005; Pell & Jarvis, 2001; Varelas, House, & Wenzel, 2005). Although one would expect early childhood teachers to have more flexibility in their schedules, such a strong focus on early literacy and numeracy skills exists that many
teachers have a difficult time fitting subjects that are considered less essential into their school day (Forbes and Davis, 2008; Mantzicopoulos, Patrick and Samarapungavan, 2008; “New Science Software,” 2007; Worth & Grollman, 2003). As one teacher stated, “Seeing that science was the last thing that we did do for the day…So I mean I think time was a big factor. I didn’t spend enough time on teaching science” (Varelas et al., 2005, p. 510). In one study, only 13% of first grade students learned science from their teachers on a daily basis. (National Center for Education Statistics, 2006).

Because science is not prioritized in early childhood, studies have shown that young children often show lower readiness and knowledge of science (“Start Science Sooner,” 2010). Additionally, children may form negative attitudes about science at an early age (“Start Science Sooner,” 2010).

**Standards and Accountability**

Accountability concerns have been pushed down to an even younger age (Hatch & Grieshaber, 2002). The science standards created by the National Committee on Science Education Standards and Assessment begin in the kindergarten years (as cited in Helm & Gronlund, 2000), years included in the definition of early childhood education. As of 2009, preschool science standards had been written in 12 states (Sackes, Trundle, & Flevares, 2009) as well. In Colorado, the Colorado Department of Education included six standards related to science in its preschool standards (*New Colorado P-12 Academic Standards*, 2012). They are as follows:

- Objects have properties and characteristics.
- There are cause-and-effect relationships in everyday experiences.
- Living things have characteristics and basic needs.
• Living things develop in predictable patterns.
• Earth’s materials have properties and characteristics that affect how we use those materials.
• Events such as night, day, the movement of objects in the sky, weather, and seasons have patterns (Colorado Preschool Program Staff, 2011, p. 3).

With the focus on accountability, how can preschool teachers ensure children are given a solid science learning foundation before they begin elementary school?

**Early Childhood Science Curriculum**

When studying preservice teachers, Forbes and Davis (2008) found that curricular materials could help support them with their science content deficits. During the past decade, several science curricular packages for the early childhood years have been created. Preschool Pathways to Science (Gelman, Brenneman, Macdonald, & Roman, 2010), *A Head Start on Science* (Ritz, 2007), *ScienceStart!* (French, 2004; Peterson & French, 2008), *Early Childhood Hands On Science* (Brown & Greenfield, 2010), *The Creative Curriculum Study Starters* (Heroman, 2005), the GLOBE Program (Penuel et al., 2009), the Scientific Literacy Project (Mantzicopoulos et al., 2008; “Start Science Sooner,” 2010) and the *Young Scientist Series* (Chalufour & Worth, 2003; Chalufour & Worth, 2005) are all programs designed for early childhood. Many of these programs utilize an inquiry approach, but the levels of inquiry reflected in them vary. Additionally, a teacher’s beliefs about inquiry, science instruction, and utilization of packaged curricula can heavily impact how the programs are delivered.
In this age of accountability, standards, and a push-down model of curriculum, packaged curricular programs have been embraced by school districts. In one major metropolitan area, the Goodwin Public Schools system has implemented several curricula for different subject areas: *Everyday Mathematics* for math, *Units of Study* for writing, and the Houghton Mifflin reading series for reading. Implementation of these curricula vary according to the teachers using them. It is vital to examine what choices teachers make when implementing curricula, as those choices can impact the students and their learning.

**Curriculum Implementation**

The concept of fidelity of implementation reflects that teachers need to implement a curriculum as it is intended to be used by its developers. It is also referred to as fidelity, adherence, and quality of program delivery. It includes both the proportion of content attempted and the modifications to the content (Jackson-Newsom, as cited in Ringwalt et al., 2010). Some feel that teachers should use a curriculum as it is intended to be used; others feel that effective teachers adapt and change curricula to accommodate the different needs of their students. Some teachers may feel disempowered by the presence of a scripted program, thinking it stifles their creativity and professional judgment (Bolman & Deal, 2008; Crawford, 2004). Others may see a packaged curriculum as a relief, helping save them time and reducing the number of decisions they need to make. No matter how a teacher approaches a packaged curricula, she or he makes decisions regarding its use. Will the teacher implement it exactly as proposed? If not, on what basis will that teacher change, omit, or add components to it? These are questions all teachers answer, even if they are not cognizant of them. Studies need to examine how
teachers implement curricula and how the variations in their implementation affect their
own attitudes, their students’ learning, and their students’ attitudes.

Inquiry

Yet another decision teachers must make when teaching science is how much
inquiry to incorporate in their lessons. Inquiry has been defined in various ways, with
some definitive aspects being consistent (hands-on, experiential learning) and some
varying (the degrees of teacher and student control in the lesson). Engaging in inquiry-
based science allows children to conduct investigations, use tools and techniques for data
collection, “think critically and logically about relationships between evidence and
explanations” (Kallery et al., 2009, p. 1189), and communicate scientific arguments
(Kallery et al., 2009). Participation in inquiry learning helps young children engage in
genuine science activities, making their learning more meaningful (Hogan, as cited in
Kallery et al., 2009). Worth created a diagram titled Young Children’s Inquiry (see
Figure I.1). In this framework, it appears that one stage follows the previous one.
However, inquiry is not always a linear process. Children can move back and forth
through the process as they experience the world around them (Chalufour & Worth,
2003).

Often three levels of inquiry (Nadelson, Walters, & Waterman, 2010; Yager,
Abd-Hamid, & Akcay, 2005) and sometimes up to four (Mumba, Chabalengula, &
Hunter, 2007) have been defined. Even though the number of levels may vary, the
criteria for defining them is similar. Most move from one end of a continuum with open
inquiry, where the student has input into most, if not all aspects of the science experience,
to a more structured inquiry, where the teacher directs most of the activities. Teachers’
comfort levels vary in how much control they want to have in their classrooms. For instance, one teacher wrestled with the “dilemma of messiness versus structure” (Varelas et al., 2005, p. 504). Others feel that inquiry-based teaching is too difficult to implement (Gilbert, 2009) and may feel overwhelmed by the process of changing their practices (Rogan, 2007). Therefore, teachers may favor a certain level of inquiry depending upon their overall philosophies. Examining how teachers make decisions regarding different levels of inquiry is important knowledge to contribute to science research.

When examining teachers’ curricular decisions regarding implementation and inquiry, the most important question should be, how do these factors affect the students? First, it is critical to ascertain how much learning students gain from the programs. Second, it is vital to determine how these curricular packages influence children’s attitudes towards science. Attitudes towards academic subjects affect children’s learning in those subjects. Additionally, students’ attitudes directly impact how likely they will be to continue to study those topics as they get older. (Mantizicopoulos et al., 2008).

Teachers’ views about these programs are important, too. In the 1970s, Harlen stated that active teacher participation in curriculum development is crucial (as cited in Pell & Manganye, 2007). Considering teachers’ feelings about curricular programs is essential. If they dislike the curriculum, they are unlikely to use it even if it yields positive results for their students’ knowledge and attitudes.
Figure I.1  Young Children’s Inquiry.  (Chalufour & Worth, 2003, p. 116).
Reproduced with permission of Karen Worth.
Theoretical Framework

Several theories are incorporated in the theoretical framework of this study. Figure I.2 shows a visual diagram demonstrating this model. Teacher beliefs are at the top of the model, as what a teacher believes impacts all aspects of her or his teaching. For this study, three important foci related to teacher beliefs are present. First, the teacher’s beliefs about her or his identity as a teacher, specifically as a science teacher, is vital information. Second, the teacher’s beliefs about inquiry and how inquiry should be incorporated into science instruction is also important. Last, a teacher’s views of curriculum, specifically a packaged curriculum, impact how that teacher instructs the students.

The second level of the model is the decision-making step in the sequence of teaching. A teacher’s beliefs about her or his identity as a science teacher, the teacher’s beliefs about inquiry instruction, and the teacher’s beliefs about curriculum implementation will affect how that teacher makes choices in teaching science. For this level, identity theory, constructivism, and fidelity of curricular implementation play an important role. A theory related to curriculum implementation is the Concerns-Based Adoption Model, a framework developed by Hall and Hord (1987) (as cited in Ringwalt et al., 2010). This model offers six levels of curriculum implementation, from Level I (initial orientation) to Level VI (mastery). This theory resonates with my belief that teachers do not have to “read the script” to utilize a curricular package effectively.
Figure I.2 Theoretical Framework for the Study.

The last level of the model is how teacher decisions affect the students. The decisions teachers make regarding how much inquiry to include in the lessons and how closely they follow the prescribed curriculum will impact the students’ learning and attitudes. At this level, the students’ process skills acquisition and their attitudes are interconnected, so there is a two-sided arrow between those two.

This framework shows that teachers’ beliefs about their identities as science teachers, inquiry instruction, and curriculum implementation impact the types of decisions the teachers make. These decisions, in turn, affect the students’ process skills acquisition and attitudes towards science.
Research Questions and Hypotheses

This study will examine how two preschool teachers implement the *Young Scientist Series* preschool science curriculum. This curriculum was selected for several reasons. First, the program is highly experiential with a strong inquiry base. The inquiry level of this curriculum as a whole falls into the *guided* inquiry category, in between *structured* and *full* inquiry. Second, the *Young Scientist Series*, while a packaged program, offers many opportunities for the teacher to make different types of choices in implementation. Last, this program is developmentally appropriate. It would not serve the participants in this study to select a curriculum that offered a push down of content more appropriate for older learners. The *Young Scientist Series* was developed for 3- to 5-year-olds, and the lessons and activities are appropriate for that age level (Chalufour & Worth, 2003).

I developed two types of questions for the study, an overarching question and several specific research questions. The overarching question of this study is the following: How do two different preschool teachers implement a packaged science curriculum? The specific research questions are as follows:

1. What variations exist in how the teachers implement the curriculum?

   - In what ways do the teachers follow the directions of the program? In what ways do they alter the directions of the program (attempts, changes, additions, omissions)?
   
   - What teaching choices do the teachers make in relationship to science inquiry?

2. How do variations in curriculum implementation affect student science process skills (prediction, observation, investigation, using science tools) acquisition?
3. How do variations in curriculum implementation affect student attitudes towards science?

Based upon the research questions, I made several hypotheses regarding what I thought the outcomes of the study would be. I share them below:

Hypothesis 1:
Different preschool teachers will implement a packaged science curriculum in a variety of ways, depending upon their comfort level teaching science and their philosophies regarding science inquiry.

Hypothesis 2:
Teachers with an initial higher comfort level teaching science will implement the curriculum making more personal teaching choices.

Hypothesis 3:
Teachers who value science inquiry will feel freer to make adjustments to the curriculum.

Hypothesis 4:
In classrooms where teachers utilize more inquiry activities, students will show more gains in science process skills.

Hypothesis 5:
In classrooms where teachers utilize more inquiry activities (implement the curriculum more freely, making their own choices when necessary), students will reflect more positive views of science.

**Overview of Methodology**

This study used mixed methods, incorporating both quantitative and qualitative measures to investigate how teachers implement an early childhood science curriculum
and how their choices impact their students. The qualitative component of the research utilized a multiple case study design where I compared two teachers’ experiences teaching the curriculum. Criteria for inclusion was determined by inviting all of the preschools in a small suburban school district to participate and then including those teachers willing to spend the time and effort necessary to fully implement the Young Scientist Series curriculum. Student subjects were determined by selecting those students in the two classrooms whose parents consented to the study and who assented to the study themselves. Therefore, this was a volunteer sample.

This study utilized data from multiple sources. For the teacher data, quantitative data were collected by using the Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990), the Attitudes and Beliefs About Science Questionnaire Inquiry Teaching subscale (Johnson, 2004), the Preschool Science Materials/Equipment Checklist (Tsunghui, 2006) and the Preschool Science Lesson Observational Scale. Since the sample sizes were small, I compared the teachers’ scores pre and posttest to themselves and each other. I also compared their implementation of curriculum, student questions, and levels of inquiry using the Preschool Science Lesson Observational Scale, looking at total numbers and means. Qualitative data was gathered through audiotaped interviews. Interviews were transcribed, chunked, and coded using constant comparative analysis. Emergent theme statements were generated which consolidated the interview information. Following the constant comparative analysis, domain and taxonomic analyses were completed to determine relationships between the codes and ascribe connections between ideas. Inductive coding was used throughout this process, with in vivo coding used whenever possible.
Quantitative student data was gathered with the Science Learning Assessment pretest, the Preschool Student Interest Assessment, the Science Learning Assessment posttest, and the Puppet Interview Scale for Competence In and Enjoyment of Science (Patrick, Manticopoulos, and Samarapungavan, 2009) posttest. The SPSS quantitative computer program was used to generate descriptive statistics. In order to compare the groups of students to themselves pre and posttest, paired t tests were run. Independent t tests were run to compare the groups of students to each other.

**Structure of the Dissertation**

This first chapter has introduced and defined the research problem: Early childhood students are not receiving science education at precisely the time it should be introduced to them due to time and resource constraints. The research questions have been defined, and several hypotheses have been presented.

The second chapter will present a review of the literature pertinent to the study. It will offer a brief history of science education, specifically inquiry science methods and how they have evolved through recent educational history. Topics to be addressed will be teacher beliefs, teacher identity, inquiry, constructivism, curriculum, teacher decisions, and student attitudes. This chapter will present the context of this study and show how the study fits into the larger picture of science education.

The third chapter will present the research design in detail. This will include site and participant selection, description of the study’s three phases, data collection methods, teacher quantitative instruments, teacher qualitative methods, student quantitative instruments, and an overview of how the data will be analyzed.
Chapter Four and Chapter Five will each describe one case in the study. Chapter Four will present results about the first teacher involved in the study. It will examine the preimplementation surveys and interview, offering a snapshot of the teacher’s attitudes toward teaching science, curriculum implementation, and inquiry science. It will then discuss how that teacher implemented the curriculum, including the different choices the teacher made in delivering the lessons. Last, it will look at how the students performed on the process skills and attitudes toward science assessments. Chapter Five will follow the identical organizational format as Chapter Four, but will cover the information gathered from the second teacher involved in the study.

The final chapter will begin with a comparison of the two teachers. It will investigate similarities and differences between them, examining all of the data. Part of that comparison will involve examining the patterns between the teachers’ choices in curriculum implementation and their students’ process skills and attitudes towards science. Conclusions and inferences derived from the data will be shared and explored. After that, I will revisit the hypotheses presented in this chapter and determine whether or not they were realized. Limitations of the study will then be outlined, which will lead to ideas for further research on the topic of early childhood science education. The dissertation will conclude with a brief synthesis of the findings of the study.
CHAPTER
II. LITERATURE REVIEW

Introduction

In this chapter I will review the literature pertinent to this study. I will offer a brief summary of the history of science education. Then I will summarize information on teacher beliefs, teacher identity, constructivism, inquiry, curriculum implementation, the Concerns-Based Adoption Model, teacher decisions, and student attitudes. All of these topics play a role in the conceptual framework presented in Chapter 1.

Historical Background

During our country’s history, the subject of science has gone through periods when it was highly valued and times when it was subordinated to other content. In the late 1950s, the Soviet space exploration prompted our country to reexamine science and prioritize it in education (Ogawa, Loomis, & Crain, 2008; Yager, 2000). Reform efforts in both the private sector and in public education began to emerge. At that time interactive, hands-on museums such as the Exploratorium opened, reflecting a different model for imparting knowledge from museums prior to that time (Ogawa et al., 2008). Around the same time, the National Science Foundation started supporting the development of science curricula, notably curricula that emphasized inquiry methods of instruction. Although these programs were initially embraced, interest in them was not sustained (Ogawa et al., 2008). During the 1970s, science took a backseat to other subjects again. The Back to Basics movement propelled other subjects into the limelight.
In the past decade of massive educational reforms, however, people are recognizing the importance of science education in our society.

Science programs developed in the 1960s and 1970s bear some striking philosophical similarities to the programs created in the past decade. The Elementary Science and Science: A Process Approach curricula both focus on inquiry as the primary method to impart scientific knowledge to students (Rakow & Bell, 1998). Most reform movements and studies contend that utilizing an inquiry science approach is the most effective way to teach science (Lind, 1999). Reflecting this viewpoint, an emphasis on inquiry science has been advocated by the National Research Council ("Start Science Sooner," 2010).

**Teacher Beliefs**

Teachers’ beliefs often affect how they view themselves, their students, their curriculum, and the subjects they teach. Teachers’ science knowledge and science attitudes should concern researchers (Eshach, 2003) because early childhood teachers’ attitudes are important factors influencing their success in teaching science (Yoo, 2009). During the 1990s, research in teacher education examined teacher beliefs. These studies looked at where the beliefs came from, how easy they were to change, and how they impacted the teacher’s classroom teaching (Richards, as cited in Eick & Reed, 2002). In order to help improve science instruction, researchers need to learn how teachers’ feelings about science impact their instruction (Ginsburg & Golbeck, 2004).

Many teachers’ beliefs are deeply rooted in their prior experiences in science and their educational endeavors. Luehmann (2007) found that a student teacher’s learning background and prior work experiences impacted her or his views of science teaching.
Often teachers respond differently to phenomena depending upon their philosophies, the strategies they learned, and their experience with previous reform movements (Coburn, 2004). Sometimes these prior learning experiences are at odds with effective, inquiry-based science instruction (Luehmann, 2007). Zembylas stated, “If we want progress in science education, we need to look more carefully at the emotions of science teaching, both negative and positive emotions, and use this knowledge to improve the working environment of science teachers” (Saracho & Spodek, 2008, p. 74). Gilbert’s (2009) study followed the assumption that teachers’ actions are based on their belief systems, and understanding those belief systems can help promote new science teaching techniques (Simmons et al., 1999).

Although the affective component of teaching may be crucial to learning, it is often not given consideration when planning preservice or inservice programs (McPherson, 2009). Interest, motivation, and science teaching efficacy are important in influencing teacher-leaders in science (Lewthwaite, 2006).

The way we feel intrinsically about a subject strongly influences our teaching of the subjects. We devote more time to it and we teach it more passionately. I don’t think many of us are that intrinsically interested in it…we see it in many of the children though…it all has a real effect on us by motivating us to teach science (Lewthwaite & Fisher, 2005, p. 596).

When teachers do not feel they have science teaching efficacy or they have little support from their colleagues, their development as science teachers is hindered (Lewthwaite, 2006).
As stated in Chapter 1, one problem facing science education today is the fact that elementary teachers have negative attitudes towards science (Koballa & Crawley, as cited in Eshach, 2003). Some teachers’ negative attitudes stem from a belief that they do not have strong enough content knowledge in science to teach the subject effectively. These attitudes can influence their students. Teachers’ emotions affect young children because teachers can create a nurturing or discouraging atmosphere in the classroom for science learning (Saracho & Spodek, 2008). According to Marilou Hyson, an Associate Director for the National Association for the Education of Young Children, teachers’ interest levels also can trickle down to their students (as cited in Jacobson, 2002). Because their attitudes impact their students, we need to help early childhood teachers change their attitudes towards science instruction (Yoo, 2009).

Studies regarding teachers’ attitudes have had mixed results. On one side, Eshach (2003) found that marked changes in teachers’ beliefs systems in science instruction can be achieved in a short time. Yoo (2009) shared that early childhood teachers who were involved in Yoo’s case study developed a stronger interest in science education and became more positive about science teaching. Additionally, using informal settings to educate teachers can help teachers change their epistemologies of science teaching (Katz et al., 2010) and benefit them affectively. Participating in the Scientific Work Experiences Programs for Teachers enabled teachers to develop more positive views of science teaching and more inquiry-based instructional methods (Dubner et al., 2001). Woolhouse and Cochrane (2010) showed that teachers involved in the Science Additional Specialism Programme developed a renewed interest in science, becoming enthusiastic about the subject again.
Other studies are not so positive. People’s beliefs can be difficult to change, and they do not easily change their beliefs based upon arguments or reasoning (Enyedy, Goldberg, & Welsh, 2006). Luehmann (2007) reported that, even when offered classes and field experiences, many teacher candidates did not alter their views about themselves as a science teacher. Sometimes teachers simply do not want to change, so they ignore reform efforts (Sofou & Tsafos, 2010).

Regardless of whether or not teachers’ belief systems can be changed, their belief systems impact how they teach science, which also affects how their students learn. In this dissertation the teachers’ beliefs and their role in curriculum implementation will be investigated.

**Teacher Identity**

Schwartz (2001) offers a historical view of identity theory, beginning with Sigmund Freud, continuing with Erik Erikson, and moving towards more recent identity theorists. Although Sigmund Freud (1930/1965) was one of the first theorists to discuss the question of self-definition, Erik Erickson was the first to form a full-fledged identity theory, publishing his first writings on identity in the 1950s (Schwartz, 2001). His definition of identity considered both internal and social contexts (Schwartz, 2001). After Erikson, Marcia was the first neo-Eriksonian identity theorist to generate significant research writings (Schwartz, 2001).

Since the 1980s six additional theorists built upon the earlier work, presenting new identity models. These six models were influenced by Erikson and Marcia (Schwartz, 2001), and they either extended or expanded upon the earlier identity models. They considered “consideration of individual differences; the search for, discovery, and
utilization of innate potentials; critical problem solving skills, social responsibility; integrity of character; social and cultural contexts; and all three levels of identity introduced by Erikson” (Schwartz, 2001, p. 48). Identity theory looks at the interplay between how a person views him or herself and how that person is seen by others (Luehmann, 2007).

A person’s sense of identity, whether it is constructed internally or externally, influences how he or she behaves. The identity to be considered in this dissertation is how teachers view themselves as science teachers and curriculum implementers. Forbes and Davis state that identity is a function of many interrelated factors: “knowledge, beliefs, self efficacy, and general dispositions toward teaching practice and the evolution of these characteristics over time through classroom practice” (Drake, Spillane, & Hufferd-Ackles, 2001; Forbes & Davis, 2008, p. 911). Learning is a part of this (Hoveid & Hoveid, 2008). Luehmann posited that identity is “constituted in interpretations and narrations of experiences” (Luehmann, 2007, p. 827), meaning that a teacher’s personal history and life stories impact her or his identity as a reform-based educator. Kagan’s literature review (1992) examines studies whose results show the impact of life history on the way a preservice teacher sees him or herself as a certain kind of teacher.

Hoveid and Hoveid (2008) state that people’s actions are closely connected to their profession, stating that teachers are members of a group of teachers, but they are also individuals. Teachers reveal themselves by their actions, and they project their teacher-identity into the world. Luehmann builds upon Gee’s definition of identity, stating that a teacher’s professional identity is being viewed by that teacher and other people as being a certain type of teacher (as cited in Luehmann, 2007).
Studies have been conducted on preservice teachers and how their beliefs influence how they begin to teach science (Eick & Reed, 2002; Katz et al., 2010). Several researchers have looked at identity as a lens to look at how preservice teachers see themselves as scientists and science teachers (Varelas et al., 2005). Katz et al. (2010) used a professional identity development lens to figure out how teacher candidates’ beliefs about science teaching and learning related to how they saw themselves as future science teachers. They drew the following conclusions regarding science teacher education: Teacher preparation should give preservice teachers the ability to be seen as knowledgeable and confident in reform-based science teaching practices. Additionally, training for preservice teachers should encourage those future teachers to be seen as showing excitement for science and modeling that excitement to their students when they teach science (Katz et al., 2010).

Woolhouse and Cochrane (2010) posited that teachers’ professional identities not only cover how they view their subject and knowledge of teaching, but are an ongoing story of how they develop a professional self over time. Eick and Reed (2002) researched how identity influenced inquiry-teaching practices. In their study, they found that preservice teachers who engaged in structured inquiry on a regular basis developed stronger identities as inquiry-oriented teachers. The teachers’ past histories came into play when developing these identities, including science courses and work experiences (Volkman & Anderson, 1998). Luehmann (2007) felt that teachers need to develop identities that align with inquiry-based reform practices in order to improve science instruction. Identity is constantly changing, (Luehmann, 2007). Therefore, if beginning
teachers’ role identities can be shaped to identify more strongly with inquiry, reform in science teaching can be promoted (Eick & Reed, 2002).

Luehmann (2007) believed that becoming a reform-based science teacher involves creating a new identity as a reform-minded science teacher, one that challenges the current norm of science instruction (Cochran-Smith, 1991). Likewise, when a teacher has a greater role identity as a traditional teacher, that may hinder the teacher’s ability to implement inquiry-based strategies (Luehmann, 2007). Gee also contends that professional identity may play an important component in how teachers teach science (as cited in Katz et al., 2010). Other researchers have examined the interplay between how teachers see themselves and compared those views to their observed practices (Enyedy et al., 2006; Johnson, 2004). Looking at how teachers implemented a curriculum titled GLOBE helped researchers see if variations in teachers’ identities caused them to implement the curriculum differently. Considering identity and practice at the same time is important, as the two constructs are interconnected (Enyedy et al., 2006).

Identity has also been used as a way to examine curriculum implementation. Forbes and Davis focused on “those aspects of preservice elementary teacher’s role identities specifically related to their use of curriculum materials for elementary science teaching” (Forbes & Davis, 2008, p. 912). The idea of curricular role identity offers a “zoom lens” angle on role identity (Forbes and Davis, 2008, p. 912). In terms of science, curricular role identity considers how preservice teachers view use of materials to encourage inquiry, students’ questions, evidence, how explanations are developed, and students’ ideas (Forbes & Davis, 2008). Forbes and Davis (2008) feel that preservice teachers should be encouraged to create a curricular role identity where curricular
resources are valued as teaching tools. These identities can be influenced by education and classroom contexts (Forbes & Davis, 2008). They also found that teacher characteristics, such as how they utilize curricular materials, were important. (Forbes & Davis, 2008).

Preservice elementary teachers will become actively involved in their own curricular role identity when they work with science curriculum materials. (Forbes & Davis, 2008). Furthermore, a teachers’ awareness of her or his identity as a science teacher will help that teacher consider changes in practice in a more thoughtful way (Enyedy et al., 2006).

**Constructivism**

The theory of constructivism has played an important role in informing inquiry-based teaching practices. It is a developmental (Gelman & Brenneman, 2004), multi-faceted approach to learning because it considers both theory and practice (Bush, 2006). Constructivism examines learning with a cognitive lens. It posits that knowledge is constructed by the learner through experience (Bush, 2006), thus focusing on the learner as the main player in his or her learning (Lorsbach & Tobin, 2004). The learner’s mind is actively involved in seeking and assimilating knowledge (Gelman & Brenneman, 2004). In the 1970s, Jean Piaget recommended “the use of active methods which give broad scope to the spontaneous research of the child or adolescent and require that every new truth to be learned be rediscovered or at least reconstructed by the students, and not simply imparted to him” (as cited in Doris, 1991, p. 3).

Some have recommended that hands-on science instruction should be utilized when developing instructional programs (McKeown, 2003). A focus on hands-on
methods helps children become engaged in language (Rillero, 2005) and positive interactions with peers (Conezio & French, 2002). The hands-on approach helps elementary children learn science more effectively by using manipulatives to explore the world (McKeown, 2003). When a teacher uses hands-on methods combined with discussions about what is happening, children’s science skill development is increased (Rillero, 2005). This method also helps improve their creativity and attitudes towards science. (Rillero, 2005).

These hands-on classrooms may show children playing and experimenting with different materials. Although this may be fun and may cause children to generate questions, it is not enough of an activity to be considered constructivist (Chaille & Britain, 2003; Eick & Reed, 2002). Just because a teacher uses hands-on activities does not ensure that children are involved in meaningful inquiry (Saracho & Spodek, 2008). Involvement in a task is desirable, but this involvement is not enough in itself to help the students learn important concepts (Howes, 2008). Additionally, young children can learn more than people previously thought, and that has helped us understand that early childhood education should entail more than just play alone (Ginsburg & Golbeck, 2004).

Karen Worth stated that many preschool teachers plan isolated science activities, setting up a science table and thinking that is sufficient for science instruction (as cited in Jacobson, 2002). Such activities do not encourage attainment of a deeper scientific knowledge base (Winnett et al., as cited in Gelman & Brenneman, 2004). Isolated pockets of unconnected, fragmentary science activities (Kallery et al., 2009) will not likely affect the development of children’s knowledge, skills, and motivation (Patrick, Mantzicopoulos, & Samarapungavan, 2009). Children need adults to help them make
those deeper connections (Fleer, 2009; Howes, 2008). Teacher input can enable the children’s experiences to be “considered educative” (Howes, 2008, p. 542). In order to be effective teachers in a constructivist science classroom, teachers need to be able to understand the subject of science and the nature of scientific inquiry (Saracho & Spodek, 2008).

**Inquiry**

When science reform movements have occurred, usually the term *inquiry* has been at the heart of them (Aulls & Shore, 2008). In fact, one focus of a standards-based curriculum is understanding inquiry (Flick & Lederman, 2005). The National Science Education Standards have given great importance to inquiry-based science teaching (Chiappetta, 2008). Inquiry is included in three of the six overarching science standards (Friedl & Koontz, 2005). The science teaching standards also state that teachers need to be able to plan inquiry-based science programs (Friedl & Koontz, 2005).

Inquiry learning has many components. Defining inquiry concisely can be a challenging task. One aspect of inquiry learning is the following, a shift of emphasis from teachers imparting knowledge to students learning through engagement (Eick & Reed, 2002; Friedl & Koontz, 2005; Rakow & Bell, 1998). Inquiry skills include asking questions (Friedl & Koontz 2005; Worth & Grollman, 2003), making observations (Conezio & French, 2002; Worth & Grollman, 2003), planning investigations (Conezio & French, 2002; Flick & Lederman, 2005; Friedl & Koontz, 2005; Kallery et al., 2009; Worth & Grollman, 2003), collecting data (Friedl & Koontz, 2005; Kallery et al., 2009; Worth & Grollman, 2003), and communicating the findings (Conezio & French, 2002; Flick & Lederman, 2005; Friedl & Koontz, 2005; Kallery et al., 2009; Worth &
Grollman, 2003). Developing these process skills is important in science (Kallery, 2004). When scientists generate and answer questions about the world, they are engaged in the process of inquiry (Chaille & Britain, 2003).

Inquiry helps children experience science in a meaningful way, which enables them to improve their understanding of science (Ornstein, 2006). It helps them engage in scientific (Luehmann, 2007) and critical thinking (Kallery et al., 2009). These critical thinking skills can help children develop deeper knowledge.

Inquiry teaching is an approach that many professional groups advocate (Chiappetta, 2008; Eshach, 2006), including the Benchmarks for Science Literacy (Saracho & Spodek, 2008) and National Research Council (“Start Science Sooner,” 2010). Some feel that inquiry-teaching is crucial to effective science instruction (Aulls & Shore, 2008) and should be an integral part of science instruction instead of something added on when time permits.

Chalufour and Worth (2003) write of inquiry with young children, describing it as a circular process (see Figure I.1 in Chapter 1). Children go through different stages where different inquiry skills are used. Although it seems like one stage should logically follow another, sometimes the process is not linear. Children will often move back and forth from one stage of inquiry to another.

Inquiry teaching has shown positive results. Some feel that students at all levels should be able to engage in scientific inquiry (Eshach, 2006; Ornstein, 2006), including children in kindergarten through second grade (Eshach, 2006). It has shown affective gains in students (Ornstein, 2006), and one group found that the gains were particularly marked in females in terms of nurturing their enjoyment of science (Patrick et al., 2009).
When defining a term, it is sometimes useful to look at what the term is not. Therefore, lessons that give procedures that are already determined with known results are usually not considered inquiry (Eick & Reed, 2002). While the more traditional lecture approach to teaching science has enabled teachers to cover many topics, the student learning coming from them has been disappointing. Although students can regurgitate what they have been told, they do not have a deep understanding of science concepts (Rezba, 1996). Additionally, this approach to teaching often causes students to lose interest in classes (Stipek, 2006) and stop taking science courses as soon as they can (Rezba, 1996). Science teachers who transmit knowledge through didactic methods are very different from ones teaching in constructivist classrooms (Pell & Manganye, 2007).

Levels of Inquiry

In most of the inquiry literature, different levels of inquiry are presented. Determining the level of inquiry is based upon an interplay between how involved the student is in the science experience and how involved the teacher is. Yager et al. (2005) offer three different levels of inquiry; structured, guided, and full. These authors took a lesson plan from the Exploratorium on making foam and adapted it to three different levels of inquiry. For the structured inquiry, they provided a worksheet for students to complete on how to make foam. The worksheet gave specific directions for the students to follow. The guided inquiry experience followed the Exploratorium’s initial lesson plan. The full inquiry experience enabled the students to experiment freely without mention at all of how to make foam. These authors looked at how engaging in different levels of inquiry influenced teachers’ questions and actions in the classroom (Yager et al., 2005).
The Exploratorium’s website offered the foam activity mentioned above and defined the three activities as *Guided Activity*, *Challenge Activity*, and *Inquiry Activity* (“Making Foam”). The Guided Activity provided a worksheet for the students, the Challenge Activity offered a challenge to build a tower of foam following certain parameters, and the Inquiry Activity explored the materials and foam at the station. These activities appear to be slightly different than the ones Yager et al. (2005) provided.

Mumba, Chabalengula, and Hunter (2007) used similar terms in their discussion of inquiry levels, but they cited four levels of inquiry. Their definitions were based on the work of Tafoya, Sunal, and Knecht (as cited in Mumba et al., 2007). These were *confirmation inquiry*, where students are given an answer and asked to verify it. In *structured inquiry* activities, students are given a problem and they have to figure out how to complete the activity with instructions. *Guided inquiry* gives the students a scientific problem, but they have to figure out how to solve it. The last level is *open inquiry*, where students generate their own hypotheses and figure out how to test them (Mumba et al., 2007).

Nadelson, Walters, and Waterman (2010) provided four levels of inquiry in their definition, but used only three in their research implementation. Their research examined how different levels of inquiry affected undergraduate students’ affective and cognitive outcomes. The inquiry rubric presented by this team was based upon Schwab’s work (1962). Although Chiappetta & Adams (2004) also listed four levels of inquiry, they were defined slightly differently. Their levels looked at the connections between process and content. The first level was *content*, which was defined as an emphasis on presenting and explaining ideas. The second level was termed *content with process*. In this level,
they emphasized using active learning methods to construct knowledge. The third level, *process with content*, focused on learning how to investigate. The last level, *process*, was a focus on acquiring science process skills (Chiappetta & Adams, 2004). Therefore, their continuum had content on one end and process on the other, with an interplay between the two in the middle (Chiappetta & Adams, 2004). Inquiry activities can be viewed as a means to an end, the way students learn science knowledge in a meaningful context.

Like Nadelson et al. (2010), Fay and Bretz (2008) were also influenced by Schwab. They offered a rubric which divided a laboratory activity into three parts. The components were as follows: the problem or question, the procedure used, and the solution of conclusion. For each of these areas, the rubric gave two different possibilities, whether or not these activities were student or teacher generated. In the lowest level (0), the teacher generated the problem, the procedure, and the solution, while in the highest level (3), the student generated them. Levels 1 and 2 had different degrees of student and teacher involvement.

Different levels of inquiry can impact student learning in different ways. One study found that students in classroom with higher levels of inquiry had more positive attitudes towards science than students in classes with lower levels of inquiry (Ornstein, 2006). Inquiry activities can vary widely in the amount of structure they give to students to make investigations, and different levels of inquiry can be appropriate (Fay & Bretz, 2008), depending upon the activity and age of the students.
Curriculum Implementation

Many opinions have been shared about the nature of curriculum implementation. On one side are the people who feel that teachers must follow a curricular package strictly in order to realize its full positive impacts on students. Others see implementation as a continuum, with teachers in different stages adapting the curriculum (O’Donnell, 2008). The characteristics of the individual teachers (teacher identity) may explain differences in the teachers’ fidelity of implementation (Pence, Justice, & Wiggins, 2008).

Fidelity of implementation describes how closely a teacher follows the program according to the directions of the developers (O’Donnell, 2008; Pence et al., 2008). O’Donnell (2008) wrote a comprehensive review of fidelity of implementation. When looking at curricular implementation fidelity, three areas are often considered. First, program differentiation is the extent to which a teacher adheres to the crucial parts of a program. Second, program adherence examines how closely a teacher delivers the program components according to the manuals. Last, quality of program delivery looks at how enthusiastic and prepared a teacher is when implementing a program (Pence et al., 2008.) Some believe that teachers should teach the curriculum presented as closely to the way it was intended to be used as possible (O’Donnell, 2008), while others imply that allowing teachers to make their own decisions regarding curriculum is important (Sofou & Tsafos, 2010). Most feel that getting teacher input and buy-in is an effective way to ensure effective implementation (Henning & King, 2005).

The reality is that most educators do modify the curriculum they have been asked to utilize (Roach, Kratochwill, & Frank, 2009). Teachers taught only about three-fourths of the curriculum steps the first time they used a drug prevention curriculum (Ringwalt et
al., 2010). Odom et al. (2010) found similar results when studying implementation of a national early childhood curriculum. Teachers did not implement it in the way the developers intended (Rogan, 2007). Even in studies where policy makers sought curricular alignment, implementation rates disappointed them (Penuel et al., 2009).

Several factors can influence and hinder implementation of a new program. One of them is lack of time to prepare for the implementation (Lewthwaite & Fisher, 2005; Penuel et al., 2009; Wai-Yum, 2003), which is a factor presented in the problem section of Chapter 1. Lambert and Capizzano (2005) stated that it is not easy to reach full curriculum implementation: Sometimes it may take as long as two years. Early childhood teachers also view curriculum differently. They see it as more flexibly implemented, and many stated they are unable to utilize a curricular framework that has been dictated (Sofou & Tsafos, 2010).

Teachers’ fidelity of implementation can affect student achievement, particularly in schools with low initial achievement scores (Odom et al., 2010). Examining the connections between variations in implementation and student outcomes should be a focus of research (Ginsburg & Golbeck, 2004; O’Donnell, 2008). In five studies cited by O’Donnell (2008) all of them showed higher outcomes when the curricular programs were taught with greater fidelity.

Sometimes the type of curriculum was a component in how it was utilized. A curriculum that is more prescribed with clear plans can be implemented more easily than one that focuses more on instructional processes (Pence et al., 2008). Other studies found that highly structured activities were rejected by the teachers, who figured out different ways to address the goals of the curriculum (Burgess et al., 2010). Others stated that the
amount of the curricular content and the quality of the instruction were important factors to consider when evaluating the impact of a curriculum (Odom et al., 2010).

Different researchers have used different instruments to help them evaluate how a curriculum is delivered (Hahn, Noland, Rayens, & Christie, 2002; Odom et al., 2010; Pence et al., 2008; Rogan, 2007). This has been done at many levels, including preschool (Lambert & Capizzano, 2005; Odom et al., 2010; Pence et al., 2008). Studies have also looked at changes teachers have made in curriculum implementation (Burgess et al., 2010). Early childhood science curricula have also been evaluated (Patrick et al., 2009) and have been shown to have positive effects on learning (French, 2004; Samarakungavan Manticopoulos, & Patrick, 2008) and attitudes towards science (Mantizicopoulos et al., 2008; Patrick, Mantzicopoulos, & Samarapungavan, 2009).

**Concerns-Based Adoption Model**

Hall and Hord created a curriculum implementation in the late 1960s as a result of their research in schools and universities (Roach et al., 2009). This model has been used by other researchers as a helpful framework for gaining insight into how teachers’ questions and concerns during adaptation and implementation of teaching practices develop (Christou, Eliophotou-Menon, & Philippou, 2004; Dass, 2001; Roach et al., 2009). It has been called the most “robust” and “empirically grounded theoretical model for the implementation of educational innovations to come out of education change research in the 1970s and 1980s” (Anderson, 1997, p. 331). Within the model, three frameworks examine and evaluate how teachers utilize new programs: Stages of Concern, Levels of Use, and Innovation Configurations (Roach et al., 2009). This section will focus on the Levels of Use framework. Instead of viewing curriculum implementation as
an all-or-nothing endeavor, C-BAM’s Levels of Use framework looks at different stages in a teacher’s implementation (O’Donnell, 2008).

Hall and Ford determined eight levels of implementation. The first three levels constituted non-use (Roach et al., 2009). The first, Level 0, constituted complete non-use. The second, Level 1, involved orientation to the program. Level 2 was the preparation phase, where the teacher learned about the program and made plans on how to start using it (Ringwalt et al., 2010; Roach et al., 2009).

The last five levels of implementation employed varying degrees of implementation (Roach et al., 2009). Level 3 was the stage where teachers started using the program in a very mechanical, rote-like manner. When they got to Level 4a, teachers moved towards routine use, making few changes. At Level 4b, they started making changes to better address the needs of their students. Level 5, Integration, was the point when teachers started to collaborate with their colleagues to make changes that would benefit their students. Level 6 was the highest level in the model. It was characterized by teachers reevaluating the curriculum, making major changes in the curriculum to help their students, and setting new goals. (Ringwalt et al., 2010, Roach et al., 2009).

The C-BAM model implies that when teachers first utilize a curriculum, they will follow it in a mechanical way, closely following the teachers’ guide. As they become more familiar with the curriculum, they will then start to make changes (Ringwalt et al., 2010). The implication is that a teacher’s use of the curriculum will evolve when that teacher gains experience with the program and receives professional development. The use will shift from being concerned about how it impacts the teacher personally to how it will impact others (Roach et al., 2009).
The implication of the C-BAM model is that following a curricular program to the letter does not necessarily constitute the most effective use of it. This model implies that curricular implementation reflecting teacher choices and professional decisions is of a higher level than merely teaching the curriculum as presented. This goes against the “fidelity of implementation” argument that, in order for an intervention to be effective, it needs to be followed as the developers intended it to be followed. As teachers moved towards higher levels of use of the curriculum, they made changes and adaptations based upon their students’ needs. Their students’ achievement can increase (Roach et al, 2009) as a result of these choices.

**Decisions**

Teachers make many decisions during the course of each school day. Teachers must decide how to set up their room, which supplies to use, how to schedule programs, and which meetings to attend. They also have to make decisions at each moment depending upon what is happening in their classrooms (Enyedy et al., 2006). But first and foremost, they must figure out their aims and goals. They must decide what to study and how to study it (Doris, 1991).

When implementing a new curriculum, getting “buy in” (Henning & King, 2005, p. 258) is important, as teachers are the ones who decide how the curriculum will actually be used and shaped (Chittenden & Jones, 1998; Sofou & Tsafos, 2010). There are many decision-making points for early childhood educators when changes are being implemented (Burgess et al., 2010).

Early childhood teachers benefit from being given the opportunity to choose the methods that will most successfully enable their unique students to learn the content.
(Goldstein, 2008). In fact, early childhood teachers state that the children’s needs are the most important factor in figuring out how to plan their curriculum (Sofou & Tsafos, 2010). If teachers do not have the chance to make their own choices in curriculum they become dissatisfied (Wai-Yum, 2003). Not many studies exist regarding teacher decisions in early childhood education, but Burgess et al. (2010) looked at how early childhood teachers realized curriculum initiatives. It is important to allow teachers to make choices in curricular matters, as this elevates teacher professionalism and enables them to develop the knowledge they need to make effective choices (Penuel et al., 2009).

**Student Attitudes**

Considering children’s attitudes is vital in science education. Vygotsky recognized that thought and affect are connected (Fleer, 2009). Likewise, McPherson (2009) stated that affective networks enable learning to become more emotionally significant. Feelings are a component of learning (Ginsburg & Golbeck, 2004; Pell & Manganye, 2007; Saracho & Spodek, 2008). Rachel Carson posited that emotions “pave the way for the child to want to know” (as cited in Doris, 1991, p. 17). When children show strong motivation, it helps enable inquiry learning to occur (Friedl & Koontz, 2005).

Many researchers have acknowledged the need to study students’ attitudes towards science (Ornstein, 2006; Saracho & Spodek, 2008). This focus on attitudes needs to start early (Saracho & Spodek, 2008). Further, early childhood teachers should plan experiences for children that help them develop positive attitudes towards science (Rule, 2007; Smith, 2001).
Students’ attitudes are related to their achievement levels (Patrick et al., 2009; Patrick, Mantzicopoulos, Samarapungavan, & French, 2008; Wigfield & Eccles, 2000). This works in both positive and negative ways. Having a poor attitude towards a subject can cause lower achievement, while developing a positive attitude can promote higher achievement (McKeown, 2003; Pell & Manganye, 2007). Attitudes towards academic subjects can begin early in life (Tsunghui, 2006). If young students develop negative attitudes towards science, those feelings can affect their entire educational careers (Patrick et al., 2009; Saracho & Spodek, 2008; “Start Science Sooner,” 2010).

Some state that when young students begin schooling they are enthusiastic about science (Pell & Jarvis, 2001). On the other hand, others have posited that students as young as kindergarten have negative views of science, thinking is it difficult, uninteresting, and that they are not good at it (“Start Science Sooner,” 2010). Since attitudes toward science decline as students get older (Aulls & Shore, 2008; Pell & Manganye, 2007; Saracho & Spodek, 2008), it is vital that teachers address attitudinal outcomes to promote a positive cognitive gain (Pell & Manganye, 2007; Saracho & Spodek, 2008). It is also important to promote positive attitudes in order to help students keep wanting to study science. (Eshach, 2006; Patrick et al., 2009), as they will carry these attitudes into classes as they get older (Smith, 2001). In addition to science, children’s feelings about school can affect their engagement in learning tasks (Patrick et al., 2009). A recent call has been made to return to attitudinal evaluation in science after a period of neglect (Ramsden, as cited in Pell & Manganye, 2007).

Some recent studies have examined student attitudes towards science, but they explored the topic with older children (Manticopoulos et al., 2008; Patrick et al., 2008;
Mantizicoupoulos et al. (2008) have designed extensive research studies on student attitudes towards science with kindergarten children. They showed that meaningful involvement in science activities is connected to children’s beliefs about their science process competence and skills, their enjoyment of science (Eshach & Fried, 2005), and their beliefs about what learning science entails (Patrick et al., 2009). These authors acknowledge a dearth of research examining children’s beliefs about science in the beginning of school, and they feel that that information is vital (Patrick et al., 2009). Saracho and Spodek (2008) also stated that studies that examine affect in young children and science are hard to find.

Some argue that helping children understand broad science concepts and develop positive attitudes is more important than their achievement in science courses (Ornstein, 2006). As Hadzigeorgiou stated, “It should be recognized that attitudes towards science might very well be not just as important as a strong conceptual base, but more important, since they are the prerequisites or the motivators for children’s engagement in science activities” (Hadzigeorgiou, 2001, p. 64).

Children are “in danger of losing their interest and their sense of wonder if we fail to tend to them and nourish them in this regard” (Eshach, 2006, p. 8). Perhaps most importantly, having children examine nature can help the children enjoy nature, have positive views of science, and help the future of our earth (Rule, 2007; Worth & Grollman, 2003).

**Conclusion**

This chapter has examined the constructs of teacher beliefs, teacher identities, constructivism, inquiry, curriculum, teacher choices, and student attitudes. All of these
factors play a role in early childhood science instruction. In the next chapter, I will present the methods I will use to look at how teacher choices in curriculum implementation affect children’s process skills and attitudes towards science.
CHAPTER

III. RESEARCH DESIGN

Overview of the Methods

This study used mixed methods to examine how teachers utilized an early childhood science curriculum and how their decisions impacted their students. I collected quantitative data through surveys, questionnaires, and assessments and qualitative data through interviews and observations. The quantitative data enabled me to determine the teachers’ attitudes towards teaching science, their beliefs about inquiry instruction, and the resources available to them. Quantitative student data allowed me to assess the students’ science process skills at the beginning and end of the study and their attitudes towards science at the end of the study. The qualitative research component employed a multiple case study design where I compared and contrasted how the two educators taught the curriculum. Qualitative data helped me determine the teachers’ previous science instruction, their understanding of inquiry, and their thoughts about curriculum. Utilizing both quantitative and qualitative methods enabled me to accomplish the following:

1. Achieve triangulation by using different methods to assess similar constructs (Goodwin & Goodwin, 1996; Miles & Huberman, 1994).

2. Establish complementarity by using quantitative data to assess the results of the qualitative data (Goodwin & Goodwin, 1996; Leech & Onwuegbuzie, 2007).

3. Enable data expansion by broadening the depth of the inquiry used (Goodwin & Goodwin, 1996; Miles & Huberman, 1994).
Using quantitative and qualitative means of collecting and analyzing data enhanced the credibility of the data (Goodwin & Goodwin, 1996). To put it simply, “Numbers and words are both needed if we are to understand the world” (Miles & Huberman, 1994, p. 40).

The qualitative component of the study employed a case study design as it examined the issue of early childhood curriculum through two cases in a bounded system (Creswell, 2007). I collected data on how two teachers implemented a science curriculum to explain how their curricular choices affected their students. Because the study followed two teachers in two different preschools, it was a collective case study (Creswell, 2007) with each teacher viewed as a separate case. The procedures used were replicated in both cases. The study took place in three phases, which will now be described in detail.

**Phase 1: Pre-Curriculum Implementation**

Phase 1 of the study included all activities that occurred before the utilization of the *Young Scientist Series* curriculum began (see Table III.1). It involved determining the participating sites, collecting the consent and assent forms, surveying and interviewing the teachers, administering an assessment to students, and training the teachers on the implementation of the curriculum.

**Sites** For this research, I invited all of the public preschools in a suburban public school district to take part in the study. Goodwin Public Schools included 15 elementary schools, six of which offered a preschool program within the larger school. There was
<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administer Science Teaching Efficacy Belief Instrument to teachers</td>
<td>Curriculum implementation begins with Open Exploration</td>
<td>Administer Science Teaching Efficacy Belief Instrument to teachers</td>
</tr>
<tr>
<td>Administer Inquiry Teaching subscale to teachers</td>
<td>Observations using the Preschool Science Lesson Observational Scale begin</td>
<td>Administer Inquiry Teaching subscale to teachers</td>
</tr>
<tr>
<td>Administer Preschool Classroom Science Materials/Equipment Checklist to teachers</td>
<td>Administer Preschool Student Interest Assessment to students</td>
<td>Teacher Interviews</td>
</tr>
<tr>
<td>Teacher Interviews</td>
<td>Teacher trainings on Focused Exploration</td>
<td>Administer Science Learning Assessment to students</td>
</tr>
<tr>
<td>Administer Science Learning Assessment to students</td>
<td>Additional materials distributed</td>
<td>Administer Puppet Interview Scales for Competence in and Enjoyment of Science to students</td>
</tr>
<tr>
<td>Teacher trainings on Open Exploration</td>
<td>Curriculum implementation continues with Focused Exploration</td>
<td></td>
</tr>
<tr>
<td>Materials distributed to teachers</td>
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<td></td>
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</tbody>
</table>

also one early childhood school in the district. I sent an informal electronic mail letter in March 2011 to determine interest in the project. At that time, two preschool directors indicated their interest in participating. One preschool director declined due to the preschool’s own curriculum requirements, and four directors did not respond. In August 2011 I sent another electronic mail letter to all preschool directors except the one that had
already declined. The two preschool directors who responded positively in the spring were still interested in the project. One additional preschool director declined, and the remaining three preschool directors did not respond. Two preschool directors agreed to participate, those from Wright Preschool and Burris Preschool.

**Wright Elementary School and Preschool.** Wright Elementary School had an enrollment of 312 students from kindergarten through fifth grade (J. Richardson, personal communication, October 24, 2011). Although free/reduced lunch statistics were not available specifically for the preschool children, free/reduced lunch rates for the kindergarten through fifth grade students were 32.39% (Colorado Department of Education, 2011). The complete study sample included only those children for which the complete dataset was available, and 100% of those children were Caucasian. This group returned the consent forms prior to the beginning of the curriculum implementation, so it included only those children with both pre and posttest data. It was on this group that most of this study focused. After the curriculum implementation began, more children returned consent forms. Although prestudy data was not available for these children, I still administered the poststudy assessments to these children. Therefore, poststudy data was available for more students, although it could not be used when comparing pre and posttest data. The demographic breakdown of Wright Elementary School (grades kindergarten through grade five) can be found in Appendix A.

Wright Elementary School offered a tuition-based preschool for children aged 2½-5, as well as a before and after school program for preschoolers. Wright Preschool had a simple tuition structure. Parents paid $18.00 per half day or $35.00 per full day attended. Additional fees were charged for the before and after school program (Wright
school website, 2011). None of the complete study sample participants received any financial aid. Parents enrolled their children for the half (8:36 a.m.-11:30 a.m.) or full day program (8:36 a.m.-3:13 p.m.). All children in the complete study attended for full days. Parents also chose to enroll their children from one to five days per week (Wright school website, 2011). For the complete study sample, 0% attended 1 day per week, 18.2% attended 2 days per week, 12.5% attended 3 days per week, 12.5% attended 4 days per week, and 56% attended for 5 days per week.

**Burris Elementary School and Preschool.** Burris Elementary School had an enrollment of 366 students (J. Richardson, personal communication, October 24, 2011). Although free/reduced lunch statistics were not available specifically for the preschool children, free/reduced lunch rates for the kindergarten through fifth grade students were 20.65% (Colorado Department of Education, 2011). The complete study sample included only those children for which the complete dataset was available. These were the children who returned consent forms in time for the prestudy assessment before the curriculum implementation had begun. Of those children, 85.7% were Caucasian and 14.2% were Latino. It was on this group that most of this study focused. After the study began, more children returned consent forms, and I gave them the poststudy assessments even though they had no prestudy data available. The demographic breakdown of Burris Elementary School (grades kindergarten through grade five) can be found in Appendix A. Burris Elementary School housed a tuition-based preschool program for 3- and 4-year-old children. Table III.2 reflects the tuition plan. Of the complete study sample, none of the children received financial aid. Parents enrolled their children in a half (9:00 a.m.-
Table III.2 Burris Preschool Tuition Rates.

<table>
<thead>
<tr>
<th>Number of Days Per Week</th>
<th>Cost Per Month</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Half Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$160.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$215.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$265.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$315.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$325.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$425.00</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>$525.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$625.00</td>
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</tbody>
</table>

11:55 a.m.) or full day program (9:00 a.m.-3:43 p.m.). For the complete study sample, 42.8% attended half days and 57.1% attended full days. Parents also chose to enroll their children from two to five days per week (Burris school website, 2011). For the complete study sample, all of the children (100%) attended for 5 days per week. This program included the subjects of music, physical education, computer lab, and library in their schedule for at least one-half an hour per week (Burris school website, 2011).

Comparison of the Schools. Similarities between the two preschools were many. The schools were both located in a suburban area. They both offered parents a variety of days and times of day their children could attend. For instance, both schools offered the option of varying days of attendance per week. They also both offered a half day and full day option. Both programs were tuition-based, and both appeared to be comparably priced.

Important differences in the schools must be noted. First, the class sizes of the preschools were significantly different. At Wright Preschool the class sizes were large, with as many as 24 students attending in the older preschool classroom. Burris Preschool had much smaller class sizes; the Monday/Wednesday Kindergarten Plus class had only four students and the Tuesday/Thursday afternoon preschool class had seven students. If
one considered the ratios instead of the actual numbers of students, the preschools looked more similar. Wright Preschool had two teachers in the classroom at all times, with a third teacher assisting for four-and-a-half hours per day between 10:00 a.m. and 2:30 p.m. This made the teacher-student ratio approximately 1:8 when the class was full. This was close to the Tuesday/Thursday Burris Preschool teacher-student ratio of 1:7, but still very different (double) from the Burris Preschool Monday/Wednesday ratio of 1:4.

Preschool teachers in this school district were considered classified staff, even if they held teaching degrees and certificates. The teacher who utilized the curriculum from Wright Preschool had a college degree and Certificate in Early Childhood Education, and her teammate had a teaching license.

These differences in class size and ratios presented concerns in terms of the limitations of the study. The nature of preschool enrollments is that they accommodate the parents and children they serve. Therefore, these programs all look slightly different depending upon their families’ needs. My original goal was to find two or three preschools consisting of two classrooms each with similar programs to participate in this study for a total of four to six classrooms. Two preschools with different types of programs agreed to take part, and only one classroom from each preschool participated. Thus, the sample was a volunteer sample of preschools and preschool classrooms. These limitations will be discussed more thoroughly in Chapter 6.

**Participants** For this study the district name, the school names, the teachers’ names, and the students’ names have been changed to ensure confidentiality. All staff members from both preschools were female, so I will use feminine pronouns in this dissertation when referring to the adult participants. Since the participants of this study
were both adults and children, I will use the terms teacher or teachers to describe the adult participants and student, students, child, or children to describe the child participants.

This study had two student groups. The first group I will refer to as the complete study group. These are the students whose consent/assent forms were completed before the teaching of the curriculum began. They are also the students for whom I have a complete dataset; prestudy Science Learning Assessment (SLA), poststudy SLA, and Puppet Interview Scale for Competence in and Enjoyment of Science (PISCES) scores. This group includes seven students from Burris Preschool and 16 students from Wright Preschool. Most of the data analyzed and discussed in this dissertation will focus upon the students in this complete study group.

The second group of students I will call the entire study group. This was the entire group who returned consent/assent forms, even if they were returned after the teaching of the curriculum began. Although I had complete data for some of the students in this group (it includes the complete study group), I did not have full data for all of the students. For instance, if a child did not take the PreSLA but later turned in consent/assent forms, I did administer the PostSLA and PISCES to the child. I did this because I thought that this supplemental data might be informative at some point. This group totaled 10 students from Burris Preschool and 29 from Wright Preschool. This information was generally not included in most of the data analysis and discussion of this study because the absence of prestudy data for some of the students made it difficult to compare process skills growth. If the supplemental information is used, I will clearly state that it is the supplemental information from the entire study group. It is important to
### Table III.3 Data Collection Instruments Used During Each Phase of the Study.

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Participants</th>
<th>Instrument</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Science Teaching Efficacy Belief Instrument</td>
<td>Determine science teaching beliefs prestudy</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>Inquiry Teaching subscale</td>
<td>Determine inquiry teaching beliefs prestudy</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>Preschool Classroom Science Materials/Equipment Checklist</td>
<td>Determine resources available prestudy</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>Semi-structured Interviews</td>
<td>Determine previous science instruction, curriculum views, and understanding of inquiry</td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>Science Learning Assessment</td>
<td>Assess students’ process skills prestudy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 2</th>
<th>Participants</th>
<th>Instrument</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Preschool Science Lesson Observational Scale</td>
<td>Determine choices in curriculum implementation, levels of inquiry. Figure out nature of student questions.</td>
<td></td>
</tr>
<tr>
<td>Students</td>
<td>Preschool Student Interest Assessment</td>
<td>Determine whether students preferred the topic of plants or animals</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 3</th>
<th>Participants</th>
<th>Instrument</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>Science Teaching Efficacy Belief Instrument</td>
<td>Determine science teaching beliefs poststudy</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>Inquiry Teaching subscale</td>
<td>Determine inquiry teaching beliefs poststudy</td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>Semi-structured Interviews</td>
<td>Determine views on the curriculum implementation, the curriculum, understanding of inquiry, and decisions made</td>
<td></td>
</tr>
</tbody>
</table>
Table III.3 (cont.)

<table>
<thead>
<tr>
<th>Students</th>
<th>Science Learning Assessment</th>
<th>Assess students’ process skills poststudy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Puppet Interview Scales of Competence in and Enjoyment of Science</td>
<td>Determine students’ attitudes towards science</td>
</tr>
</tbody>
</table>

note that attrition did not occur during the study. The only student assessed prestudy but not poststudy was absent the entire last week of the study when I conducted the poststudy assessments. More students joined the study after it had begun, which explains why students were divided into two groups.

**Phase 1 Teacher Data** The teacher data collected during Phase 1 consisted of three quantitative instruments and one qualitative interview. These were given before any curriculum training had begun.

**Quantitative Teacher Data.** Following the signing of the consent forms, I distributed three surveys to the teachers: the Science Teaching Efficacy Belief Instrument, the Attitudes and Beliefs About Science Questionnaire Inquiry Teaching subscale, and the Preschool Science Materials/Equipment Checklist. The teachers sharing a classroom were allowed to complete the Preschool Science Materials/Equipment Checklist together with their room partner.

**Science Teaching Efficacy Belief Instrument.** The first survey given was the Science Teaching Efficacy Belief Instrument (STEBI; Riggs & Enochs, 1990; Appendix
B). This instrument was a 25-item, Likert-type assessment with a 5-point rating scale (strongly agree, agree, uncertain, disagree, strongly disagree). The instrument had two subscales, the Personal Science Teaching Efficacy Belief scale and the Science Teaching Outcome Expectancy scale. To determine content validity, a panel of five judges knowledgeable in the construct being measured was consulted. Any items rated inconsistently by three or more of the judges were deleted from the instrument. Final reliability information reflected an alpha of .92 on the Personal Science Teaching Efficacy Belief Scale and an alpha of .77 on the Science Teaching Outcome Expectancy scale (Riggs & Enochs, 1990). Riggs and Enochs (1990) concluded that the scales were valid and offered reliable measures of the constructs involved in examining science teaching beliefs with elementary teachers. This instrument has been widely used since, and different versions of it have been developed for preservice and inservice teachers. Upon review of the scale, I determined that the scale could give valuable information on the science teaching beliefs of preschool teachers.

Attitudes and Beliefs About Science Questionnaire Inquiry Teaching subscale. The second quantitative instrument completed was a subscale of the Attitudes and Beliefs About Science Questionnaire (Appendix C; Johnson, 2004). The full instrument was comprised of several subscales, including Teacher Background, Your Attitudes and Beliefs About Teaching, Beliefs About Students, and Inquiry Teaching. It was based on the Revised Attitude Scale (Bitner, 1994), the Belief Scale (Risacher & Ebert, 1996), and the SWEPT Pre-Program Survey (Dubner et al., 2001). This instrument was used with middle school teachers, and much of the instrument is more appropriate for teachers of older students. The Inquiry Teaching subscale, however,
gives a picture of how a teacher views inquiry in teaching, which is important information for this study. Therefore, this subscale was given. It was comprised of 19 Likert-type questions with a 4-point rating (not at all, slightly confident, moderately confident, very confident). Although reliability and validity information was not available for the Inquiry Teaching subscale, content validity for the entire instrument was claimed through a review by another science inquiry expert. For the reliability, the alpha coefficient was .77 (Johnson, 2004), indicating good reliability (Leech, Barrett, & Morgan, 2008).

**Preschool Classroom Science Materials/Equipment Checklist.** The last survey the teachers completed was the Preschool Classroom Science Materials/Equipment Checklist (Materials Checklist; Appendix D). Tsunghui (2006) created this checklist to document the science-related materials found in a preschool classroom. The materials were divided into four categories. There were 19 items on the Science Materials section, 26 items on the Science Equipment section, and 10 items on the Natural Materials section (Tsunghui, 2006). Originally, items would be checked if they were able to be seen and used by the preschoolers in the classroom. For the purposes of this study, I asked the teachers to check if the items were in the classroom, even if they were stored out of sight. It was important to understand the resources teachers had available for science instruction. Since science materials were provided to the teachers for the purposes of teaching the curriculum selected, I was interested in obtaining a baseline checklist for what the teachers had available to them before the study began. For most of the items on the checklist, the teachers simply checked whether or not that item was housed in the
classroom. For two items, puzzles and videotapes/DVDs, the teachers recorded how many of each item they had in the classroom.

**Qualitative Teacher Data: Interviews.** The qualitative component of the study followed a case study model, examining two bounded cases of two teachers and their classrooms. It involved conducting semistructured interviews with the teachers twice during the study. The brief prestudy interview consisted of four questions (Appendix E) designed to ascertain the way each teacher had taught science previously, determine each teacher’s views on implementing a packaged curriculum, and assess each teacher’s knowledge of inquiry science. The semistructured format enabled me to add several additional questions that emerged as the interviews transpired.

I taped the interviews with a digital recorder and transcribed them afterwards. These interviews occurred before the training began because I wanted to know the teachers’ feelings about the topics before any training had taken place. To analyze the data, I used three qualitative data analysis methods: constant comparison, domain, and taxonomic. These methods enabled me to inductively discover themes and domains and determine the relationships between them.

**Phase 1: Quantitative Student Data** I administered the first quantitative instrument to the students as a pretest before any instruction from the *Young Scientist Series* had occurred. This test used a subscale of an instrument called the Science Learning Assessment (SLA; Appendix F). The subscale included nine questions on scientific inquiry processes. For six of the questions, the children were shown photographs and asked questions about them. The final three questions involved displaying three science tools and asking the child which tool should be used for a
specific task. The children answered verbally or by pointing to their answers. Although reliability and validity information for the subscale was not known, reliability analyses for the entire instrument showed adequate internal consistency and an alpha of .79 (Samarapungavan, Mantzicopoulos, & Patrick, 2008).

I decided to use an assessment of science process skills instead of specific science content knowledge for several reasons. The first was that this assessment closely aligns with three of the four goals of the Young Scientist Series program, which are the following:

Observe life around them more closely. . . . Develop science inquiry skills including wondering, questioning, exploring and investigating, discussing, reflecting, and formulating ideas and theories. Develop scientific dispositions including curiosity, eagerness to find out, an open mind, respect for life, and delight in being a young naturalist (Chalufour & Worth, 2003, p. 4).

At the preschool level, the importance of process skills has been noted by Kallery (2004), and all of the curricular programs considered for the study placed a strong emphasis on process skills. The second reason was that this assessment was developmentally appropriate. Paper and pencil assessments are not suitable for preschool aged children. The nonthreatening format of this assessment appeared to be enjoyable, which was an important consideration in gathering data with young children. In fact, many of the children who took the SLA stated that it was fun. Third, one component of this study was to examine teacher choices in implementing curriculum. One major choice teachers have in the Young Scientist Series curriculum is deciding after Open Exploration whether or not they want to do the Focused Exploration on plants or animals. Because I used a
process skills assessment, teachers were able to make this choice freely, as both Focused Explorations utilized science process skills. Therefore, the research question regarding teacher choices was more authentically explored.

**Teacher Training**  In September, I met with all staff members from the two preschools, including teachers, teachers’ assistants, and directors. One evening five Burris Preschool staff members attended the training, and the following week six Wright Preschool staff members attended the training. The introductory session lasted two hours. For the training, I utilized the *Discovering Nature with Children Trainer’s Guide* (Chalufour & Worth, 2003) as well as the *Discovering Nature DVD* (Worth, Chalufour, Moriarty, Winokur, & Grollman, 2003) that contained real-life vignettes of the curriculum used in the classroom. The purpose of the training was to (a) orient the teachers to the curriculum, (b) give them a deeper understanding of inquiry science, (c) provide them with materials for the first phase of the implementation, and (d) answer any questions they had about the curriculum. An outline of the training activities is included in Appendix G. Although the instructional sessions were separate for the preschools due to confidentiality, I followed the same outline for both schools. The two differences in the trainings were that the Burris session took place at the preschool, while the Wright sessions took place at the preschool director’s home. Additionally, the Wright preschool staff ate dinner during the training. Therefore, the Burris training occurred in a more formal environment than the Wright training. Other than these differences, the trainings were identical in content. After the training, one teacher from Burris Preschool and one teacher from Wright Preschool decided to fully participate in the study and teach the
<table>
<thead>
<tr>
<th>Items</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>clipboards</td>
<td>1 per student</td>
</tr>
<tr>
<td>tongue depressors</td>
<td>4 per student</td>
</tr>
<tr>
<td>hand lenses</td>
<td>1 per student</td>
</tr>
<tr>
<td>small flashlights with batteries</td>
<td>6 per classroom</td>
</tr>
<tr>
<td>flexible cutting board</td>
<td>6 per classroom</td>
</tr>
<tr>
<td>disposable containers</td>
<td>6 per classroom</td>
</tr>
<tr>
<td>hand trowels</td>
<td>6 per classroom</td>
</tr>
<tr>
<td>measuring tape</td>
<td>2 per classroom</td>
</tr>
<tr>
<td>Peter First Field Guides- <em>Trees, Wildflowers, Urban Wildlife, Insects, Butterflies/Moths, Reptiles and Amphibians, Birds of North America, Mammals</em></td>
<td>1 of each for a total of 8 per classroom</td>
</tr>
<tr>
<td>posters- <em>Frog Life Cycle, Butterfly Life Cycle, Plants Life Cycle, Exploring Insects</em></td>
<td>1 of each for a total of 4 per classroom</td>
</tr>
<tr>
<td>large terrarium with gravel and charcoal</td>
<td>1 per classroom</td>
</tr>
<tr>
<td>spray bottle</td>
<td>1 per classroom</td>
</tr>
<tr>
<td>books-<em>From Seed to Pumpkin, Bugs Are Insects, Ducks Don’t Get Wet, How A Seed Grows, From Tadpole to Frog, Fireflies in the Night, From Caterpillar to Butterfly</em></td>
<td>1 of each for a total of 7 per classroom</td>
</tr>
<tr>
<td>cloth bags with handles</td>
<td>1 per student</td>
</tr>
<tr>
<td>bins to hold materials</td>
<td>2 per classroom</td>
</tr>
<tr>
<td>teacher composition book</td>
<td>1 per classroom</td>
</tr>
</tbody>
</table>
curriculum. Although only two classrooms were involved in the full implementation of the program, I gave all four classrooms in the two preschools a basket containing the materials so that the other teachers would have the resources to use the curriculum, even if they were not able to utilize it fully.

Phase 2: Curriculum Implementation

The Curriculum Implementation Phase of the study included reviewing expectations for teachers, having the teachers begin teaching the lessons, observing and videotaping the teachers each week, determining the students’ subject preferences, training the teachers on the Focused Exploration section of the curriculum, and observing the teachers implement the Focused Exploration lessons.

Teaching Expectations Following the administration of the SLA for the children with consent and assent forms, the teachers began to teach the lessons. I asked them to follow the Exploring Nature with Young Children teacher’s guide (Chalufour & Worth, 2003) and teach two forty-five minute science lessons per week. For the first four weeks of the study, the teachers implemented the Open Exploration section of the guide which consisted of four steps. I suggested each teacher spend approximately one week per step. In reality, each teacher spent different amounts of time on the steps. These differences will be discussed thoroughly in Chapters 4 and 5. These steps are as follows:

“Step 1: Introduce Children to Discovering Nature” (Chalufour & Worth, 2003, p. 23)
“Step 2: Observing Living Things in an Indoor Terrarium” (Chalufour & Worth, 2003, p. 28)
“Step 3: Teach Children How to Use Naturalist Tools” (Chalufour & Worth, 2003, p. 31)
“Step 4: Ongoing Explorations and Reflections” (Chalufour & Worth, 2003, p. 34)
These were the basic parameters I gave the teachers for curriculum implementation. While I asked them to implement the curriculum, trained them, and gave them time guidelines to follow, they knew that I would be looking at the choices they made in utilizing the curriculum.

**Preschool Science Lesson Observational Scale**  A third instrument was an observational scale used during the teaching of the science lessons (Observational Scale; Appendix H). Each teacher was viewed once a week for a total of eight observations. These lessons were videotaped in order to ensure that all aspects of the lesson being observed were recorded accurately. The instrument examined the following characteristics of lesson implementation: how closely the teacher followed the lesson, how the teacher made choices in teaching the lesson, the nature of the students’ questions during the lesson, and how the teacher realized a certain level of inquiry in the lesson.

I created this observational tool by examining a model of curriculum implementation developed by Ringwalt et al. (2010). This model rated teachers on how closely the content they covered and the teaching methods they used aligned to the curriculum. The *levels of inquiry* rubric included in the observation form were taken from Fay and Bretz (2008); adapted from Schwab (1964), Herron (1971), Chinn and Malhotra (2002), Lederman (2004), and McComas (2005). I compiled the definitions of inquiry based on the works of Fay and Bretz (2008); Yager, Adb-Hamid, and Akcay (2005); Mumba, Chabalengula, and Hunter (2007); and Nadelson, Walters, and Waterman (2010). Question types were also derived from Yager et al.’s work (2005). All of these sources helped me assemble an observational instrument unique to this study, one that would give valuable information to answer the research questions.
I tried to establish the reliability of this instrument in two ways. First, it was completed eight times for each teacher. During those observations, I anticipated that for each teacher there would be a certain amount of consistency. The expectation was that a teacher’s total observational information would fall around a general mean with some outliers expected.

Another Ph.D. candidate (hereafter referred to as the research assistant) assisted with inter-rater reliability. I trained the research assistant on how to use the observation form. Both of us watched the DVD of the first lesson and coded it independently from each other. We then met to compare our observations of the lesson. The research assistant completed observations of three of the sixteen lessons for a total of 18.7% of the lessons.

Because the observation form was divided into three sections, inter-rater reliability was computed for each section of it. Then an overall inter-rater reliability was determined based on an average of the three sections.

The first section of the observation form was the Curriculum Implementation rating. For this, the coders tallied numbers of curricular attempts, changes, omissions, additions, and new methods. For each of the three lessons, I took the total for each observable action by each rater and calculated the percentage that total was for the total number of observed actions. I did this for all five types of observable actions (attempts, changes, omissions, additions, and new methods). Then I looked at the differences in the percentages for each observable action, totaled them, and subtracted that total from 100. For the first lesson, the percentage difference was 64%, for the second lesson it was 59%,
and for the third lesson it was 84%. Averaging these three percentages yielded a total inter-rater reliability of 69%. This was below the 80% level I had wanted to achieve.

The second section of the observation form categorized students’ questions. A label of *procedural* or *curiosity* was assigned to each question. When I initially met with the research assistant to look at how closely we categorized the students’ questions, we had heard different numbers of questions. For the first DVD, I heard 71 student questions and the research assistant had heard only 17. Since the questions were not transcribed, it was not possible to look at each individual question and how it was coded. Therefore, I computed what percent of the total the procedural and curiosity questions were. For my coding, 67% of the questions were procedural and 33% were curiosity. The research assistant’s coding showed 29% of the questions to be procedural and 71% to be curiosity. These percentages were very different, but may have been different because of the vast difference between the number of questions we heard. We discussed the difference in the number of questions heard and determined that I had heard more questions because I had been present for the lessons and had videotaped them. Therefore, I decided to transcribe the questions for the three lessons the research assistant would be coding.

After transcribing the questions, I sent them to the research assistant so she could categorize them. I also coded from the same transcription. Going through this process enabled us to figure out the inter-rater reliability based upon a question-by-question coding, yielding a more accurate inter-rater reliability. In addition to the predetermined codes (procedural and curiosity), both of us added the code of *unknown* for questions that did not fall into either category. More explanation of the types of questions and how they
were coded will be presented in Chapter 4 and Chapter 5. The inter-rater reliability for the question categorization was initially 74%.

Since I was striving for 80% inter-rater reliability, I then looked at how the research assistant and I had coded the individual questions. I determined that there were several questions from one of the lessons that she had coded more accurately than I, so I changed the codes for them. For instance, I had coded the questions, “What about a pumpkin?” and “What about a spider?” as procedural questions, but realized that the assistant’s coding of curiosity was more accurate. There were also several questions I had tried to fit into the predetermined codes that she had categorized as unknown. I went back and looked at those questions and changed my codes because her codes were more accurate. There was actually one question for which I changed the coding that reflected a disagreement after the change. After all of these adjustments, the inter-rater reliability for this section of the instrument increased to 80%. After reexamining the questions, I went back through the codes for all questions in the remaining 13 lessons and double checked to see if I needed to change any of my previous codes.

For the levels of inquiry section of the instrument, I looked at five components of each lesson: the rating for problem/question, the rating for procedure/method, the rating for solution, the overall rating, and the overall level of inquiry (structured, guided, or full). This gave 15 possible ratings related to inquiry for the three lessons. Although some researchers consider the ratings close enough if they are within one point of each other, I decided to only say there was agreement if the ratings were identical. This yielded a more conservative estimate of the inter-rater reliability. The research assistant
and I were in agreement on 12 out of the 15 ratings, making the inter-rater reliability for this section 80%.

The goal was that the two observers would agree on 80% of the coding, providing good inter-rater reliability. Due to time constraints, I was not able to meet again with the assistant after our initial meeting. I believe that, had we met again, we would have been able to achieve higher inter-rater reliability for the instrument. The Curriculum Implementation subscale of the instrument yielded an inter-rater reliability of above 80% in Ringwalt et al.’s study (2010). Therefore, I think that the inter-rater reliability issues stemmed from the training on how to use the instrument, not from the instrument itself. If I used this instrument again, I would make some modifications to it. The research assistant and I had decided that we could double code components of the lessons. I would eliminate that option and have us select only one choice for coding each component of the lesson. Ringwalt et al. (2010) did not double code the changes, omissions, and additions categories. Had the research assistant and I made these categories mutually exclusive, our inter-rater reliability may have increased.

Additionally, I would simplify the instrument by eliminating the New Methods section, including any New Methods in the Additions section. Separating these two constructs did not elucidate the information gained for this particular study. Last of all, I would write my own definitions of Attempts, Omissions, Changes, and Additions. Creating my own definitions for these areas would help ensure the information gained from the instrument was specific to this study.

The validity of this instrument was determined through triangulation with other data sources. I looked for convergence of data between the STEBI, the Inquiry Teaching
subscale, the qualitative interviews, and the Observational Scale to verify the validity of the scale. I expected some data to be divergent, providing more questions, but hoped that most of the data gathered would be consistent.

**Students: Preschool Student Interest Assessment** The Open Exploration period of the curriculum examined both plants and animals. During the fourth week of Open Exploration, I administered another assessment to the children involved in the study. I was interested in knowing whether or not the children were more interested in plants or animals before they moved into the Focused Exploration. Therefore, I developed a simple instrument to determine in which topic each student was more interested. The instrument was a simple, 5-item questionnaire. Students were given pictures and books of plants and animals and were asked which of these they preferred in certain situations (Appendix I). The assessment was developmentally appropriate and did not require any verbal skills at all. The child was simply able to point to the picture or book he or she most preferred. This assessment was shared with two science education experts to ensure it was an appropriate assessment. Both experts felt the instrument was suitable for use with preschoolers.

To score the assessment, I assigned one point for each choice the child selected. If a child chose both plants and animals on the questions, which some did, I gave a point for each. Because the categories were not mutually exclusive, the number of total points for plants and animals varied according to the individual child. I then calculated which topic the class as a whole preferred by tallying the number of children who preferred plants and the number who preferred animals. Both of the teachers were aware this
assessment was being given. I was willing to share the results of their class’s preferences with the two teachers.

**Training** During the fourth week of Open Exploration, I provided another training to the teachers. Although only the two teachers were directly involved in teaching the lessons, the training was open to any staff members of the preschools who wanted to attend. One afternoon three members of the Burris Preschool staff attended the training, and another afternoon four members of the Wright Preschool staff attended. The trainings each lasted one hour and fifteen minutes, and both of them occurred at the preschools. As with the initial training during Phase 1, I utilized the *Discovering Nature with Children Trainer’s Guide* (Chalufour & Worth, 2003) as well as the *Discovering Nature DVD* (Worth et al., 2003). The purpose of the training was to help the teachers transition to the Focused Exploration component of the curriculum. During the session they observed live mealworms, developed questions about them, and devised simple experiments to figure out the answers to their questions. They reviewed the inquiry process and discussed how teachers can facilitate that process. They also learned the purpose and elements of Focused Exploration. The session concluded with a review of the teaching expectations of two 45-minute periods of science per week. An outline of the training activities is included in Appendix J. The teachers were given a choice about whether or not they wanted to pursue the Focused Exploration on plants or animals, and both of them decided to study animals. Each classroom (a total of two classrooms) was given more materials to facilitate the Focused Exploration on animals (see Table III.5).

**Focused Exploration** The Focused Exploration section of the curriculum offered several choices for teachers to follow. The first, as has been mentioned previously, was
that a teacher may decide whether or not to further study plants or animals with her
students. Teachers who chose to study animals had several steps through which they
could take their students using the Discovering Nature With Young Children curriculum.
They were:

“Step 1: Search for Animals” (Chalufour & Worth, 2003, p. 80)
“Step 2: Make a Home for Visiting Animals” (Chalufour & Worth, 2003, p. 83)
“Step 3: Observe Animals Up Close” (Chalufour & Worth, 2003, p. 89)

Following Step 3, teachers could focus more closely on animals’ body parts,
animal behavior, or animal life cycles.

If a teacher chose to study plants for the Focused Exploration, that teacher could
move through several steps with her students. They were as follows:

“Step 1: Growing Plants” (Chalufour & Worth, 2003, p. 42)
“Step 2: Monitoring Plant Growth and Development” (Chalufour & Worth, 2003, p. 47)
“Step 3: Plants and Their Parts” (Chalufour & Worth, 2003, p. 52; this section offered
numerous lesson ideas for exploring the different parts of the plant)
“Step 4: Monthly Tree or Bush Observations” (Chalufour & Worth, 2003, p. 72)

Allowing the teachers to select plants or animals for the Focused Observation
offered them more individual options in implementing the curriculum. It also provided
data on what factors they used to make their pedagogical decisions.
Table III.5 Science Materials Provided to Each Classroom Phase 2-Focused Exploration.

<table>
<thead>
<tr>
<th>Items</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>mealworms</td>
<td>1 container per classroom</td>
</tr>
<tr>
<td>small mealworm container</td>
<td>1 per classroom</td>
</tr>
<tr>
<td>larger mealworm container</td>
<td>1 per classroom</td>
</tr>
<tr>
<td>apples</td>
<td>2 per classroom</td>
</tr>
<tr>
<td>potatoes</td>
<td>2 per classroom</td>
</tr>
<tr>
<td>container of oatmeal</td>
<td>2 per classroom</td>
</tr>
<tr>
<td>water snails- Inca Gold and Mystery *</td>
<td>2 of each for a total of 4</td>
</tr>
<tr>
<td>small snails *</td>
<td>a bunch</td>
</tr>
<tr>
<td>small rectangular aqua container *</td>
<td>1</td>
</tr>
<tr>
<td>container of fish food for snails *</td>
<td>1</td>
</tr>
<tr>
<td>water purifier *</td>
<td>1</td>
</tr>
<tr>
<td>information on water snails from internet *</td>
<td>1</td>
</tr>
<tr>
<td>ants</td>
<td>1 container per classroom</td>
</tr>
<tr>
<td>ant farm container</td>
<td>1 per classroom</td>
</tr>
<tr>
<td>large terrarium</td>
<td>1 per classroom</td>
</tr>
</tbody>
</table>
Phase 3: Post Curriculum Implementation

Following the eight weeks of instruction from Discovering Nature With Young Children, I moved into Phase 3 of the study. During this phase, more data were collected from the teachers and students involved in the study.

**Teacher Data** The teachers completed two of the quantitative instruments they were given at the beginning of Phase 1 of the study, the STEBI and the Inquiry Teaching subscale. Comparing their pre and post scores on these surveys provided me with valuable information about how the curriculum implementation impacted the teachers’ attitudes about science instruction and inquiry teaching. Understanding the teachers’ attitudes enabled me to revisit three of the hypotheses presented in Chapter 1. I predicted that different preschool teachers would implement a packaged science curriculum in a variety of ways, depending upon their comfort level teaching science (as evidenced by the STEBI) and their philosophies regarding science inquiry (as shown by the Inquiry Teaching subscale). I also stated that I thought teachers with an initial higher comfort level teaching science (as reflected on the STEBI) would implement the curriculum

*Materials provided to Mrs. Kennedy only, since she moved more quickly into the Focused Exploration phase.*

**Table III.5 (cont.)**

<table>
<thead>
<tr>
<th>Table III.5 (cont.)</th>
<th>1 per classroom for a total of 4</th>
<th>1 container per classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>books—Silkworms and Mealworms; Mealworms: Raise Them, Watch Them, See Them Change; Mealworms (Watch It Grow); Mealworms (Life Cycles)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>crickets</td>
<td>1 per classroom for a total of 4</td>
<td>1 container per classroom</td>
</tr>
</tbody>
</table>

*Materials provided to Mrs. Kennedy only, since she moved more quickly into the Focused Exploration phase.*
making more personal teaching choices. The third hypothesis posited that teachers who value science inquiry (as shown on the Inquiry Teaching subscale) would feel freer to make adjustments to the curriculum.

The two teachers involved in the full curriculum implementation were interviewed again. This interview was longer than the initial interview. Its purpose was to determine the teachers’ opinions about the curriculum, including its strengths and weaknesses. It also ascertained the components of the curriculum the teachers used, determined their opinions of how the students responded to the curriculum, and verified whether or not using the curriculum changed their ideas of what inquiry science meant. Questions asked may be found in Appendix E. As with the initial interviews, these interviews were taped with a digital voice recorder and transcribed.

**Student Data** The students completed two assessments during Phase 3 of the study. They took the SLA again as a posttest. Administering this assessment again allowed me to determine whether or not the teachers’ different choices in implementation affected the students’ acquisition of science process skills.

Additionally, the students participated in another scale, the Puppet Interview Scale for Competence In and Enjoyment of Science (PISCES; Patrick et al., 2009; Appendix K) in order to ascertain their attitudes about and competence in science. This 13-item instrument assessed two constructs, perceived science competence and science liking. It utilized two identical puppets who made dichotomous statements about science ("I have fun learning science" or "I do not have fun learning science"; Patrick et al., 2009). The child picked the puppet which thought the most like her or him. The alpha
levels of this instrument were .79, indicating good reliability (Leech, Barrett, & Morgan, 2008).

**Data Analysis**  The first part of this section will describe the qualitative methods I used to analyze the interview and observation data. Leech and Onwuegbuzie (2007) stated that researchers need to use two or more analysis methods in order to triangulate the results of a qualitative study, so I used three different qualitative analysis methods to increase the rigor of my study. Based upon my research questions, I selected constant comparative, domain, and taxonomic analysis methods. Following the discussion of qualitative methods, I will present the methods I used to explore the quantitative data.

**Qualitative: Constant Comparative Analysis.** I used constant comparative analysis for my initial qualitative data analysis because I wanted to explore the general questions I posed using the entire dataset to identify underlying themes (Leech & Onwuegbuzie, 2007). After transcribing the interviews, I reviewed them and grouped the questions into categories. For instance, for the first interview I selected the following categories: science instruction, curriculum implementation, and inquiry science. After that, I broke the participants’ answers into chunks. Most of the chunks were about one sentence long, with longer sentences divided into smaller chunks. I then assigned codes to the chunks using an inductive process, striving to use in vivo codes whenever possible. I felt that assigning predetermined codes to the chunks might cause me to hear what I wanted to hear instead of what was actually stated. Occasionally I assigned descriptive codes when I felt the participant’s words would not be clear enough to understand as a code. Each time I came to a new chunk of information, I determined whether or not I needed to create a new code or use an existing code for it. Part of this entailed looking at...
Table III.6 Teacher Statements on Science Instruction and Codes Assigned to Them.

<table>
<thead>
<tr>
<th>Teacher Statements</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Um, mainly as a center, science center</td>
<td>science center</td>
</tr>
<tr>
<td>And we try to do it based on the theme that we have so, um, for instance, if we did a fall theme</td>
<td>theme</td>
</tr>
<tr>
<td>We usually do a theme a week, so fall theme we try to bring in things that pertain to fall</td>
<td>theme</td>
</tr>
<tr>
<td>Um, I’m trying to think if color, when we’re doing colors, we do color mixing um,</td>
<td>colors</td>
</tr>
<tr>
<td>sometimes we’ll do a baking thing if we’re doing, um, just trying to think, um, you know gingerbread men or bread,</td>
<td>baking</td>
</tr>
<tr>
<td>or um when we do the, uh, dinosaurs we make volcanoes</td>
<td>volcanoes</td>
</tr>
<tr>
<td>We build the little baking soda and vinegar and do the little experiment with that</td>
<td>experiment</td>
</tr>
</tbody>
</table>
the main idea of the chunk. If the main idea or focus could be described with a preexisting code, I used that code. If the main idea of the chunk was not included in a preexisting code, I assigned a new code to it. Table III.6 shows a sample of statements and the codes assigned to them. After coding all of the chunks, I grouped the codes according to similarities between them. Based upon the categories that emerged, I wrote a theme statement for each topic addressed in the interviews. These theme statements (see Appendix L for an example) synthesized the information collected in a concise manner, reflecting the heart of the participants’ thoughts and feelings. They also provided me with information for the next type of data analysis I used, domain analysis.

**Qualitative: Domain Analysis.** Domain analysis was selected for two specific reasons. First, it helped me determine and understand more deeply the relationships among the different concepts and themes. Second, using this method combined with taxonomic analysis following the first interview enabled me to determine on which issues I needed further clarification for the second interview.

For the domain analysis, I used the categories selected from the interview questions. For the first interview these categories were science instruction, curriculum implementation, and inquiry science. For the second interview the categories were curriculum implementation process, curriculum strengths, curriculum weaknesses, student response, supplemental materials, inquiry science, choices, level of inquiry, appropriateness, and extra information. These categories became the cover terms for the domain analysis. For the included terms, I used the themes that emerged from the constant comparative analysis. I used all nine of Spradley’s (1980) semantic
relationships, which were the following: strict inclusion, spatial, cause-effect, rationale, location for action, function, means-end, sequence, and attribution. Going through each semantic relationship with the categories and themes enabled me to delve into the data and examine the relationships between the terms.

**Qualitative: Taxonomic Analysis.** The last qualitative analysis method I used was a taxonomic analysis. This type of analysis was used to help me understand how the teachers used specific words in their interviews. It also enabled me to see relationships between all of the terms they used. Using the domain and taxonomic analyses can help researchers formulate additional questions if they plan to interview the same participants again.

Since I had used domain analysis, I already had much of the information I needed to complete the taxonomic analysis. First, I decided which semantic relationships to use. I began by reconsidering the research questions and clarifying what I really wanted to learn from the interviews. I selected semantic relationships that would help answer those questions most effectively. I also looked at which semantic relationships would offer the most information to include in the taxonomies (Spradley, 1980). In some cases, I tried several semantic relationships and created taxonomic analyses of each. When going through them, however, I discovered that the final taxonomies were similar regardless of the semantic relationship used to create them.

After the first interview, I formed the top level of each taxonomy with the cover terms science instruction, curriculum implementation, and inquiry science. Below that, I grouped similar included terms and created the second level. After that, any other included terms that fell under the ones already written were placed under them. In this
Figure III.1 Taxonomy of Mrs. Benedict’s Responses Regarding Curriculum Implementation.

way, I developed six different taxonomies, three for each teacher. An example of one teacher’s taxonomy is included in Figure III.1. I then examined the taxonomies to determine if I needed to create further questions for the final interviews. Although I had written questions for the final interviews before the study began, I wanted to add any questions necessary to provide a deeper understanding of the teachers’ thoughts and feelings. For the second interview, I consolidated some of the related terms into the same taxonomies. For instance, the top category of one taxonomy was “curriculum,” but under
that term were the following categories: strengths, weaknesses, student response, and appropriateness. By doing this, I was able to group similar topics together. I developed twelve taxonomies, six for each teacher. Juxtaposing the taxonomies helped me compare and contrast the teachers’ prestudy and poststudy views.

**Qualitative: Preschool Science Lesson Observational Scale.** The Preschool Science Lesson Observational Scale was analyzed in a different way. For each teacher, I consolidated the data from each component of the scale, Curriculum Implementation, Student Questions, and Levels of Inquiry. I compiled a chart of all eight observations to determine patterns seen in each teacher’s overall lesson implementation. By viewing the data from all of the lessons in one place, I was able to determine how closely the teacher followed the curriculum, in what ways the teacher altered the lessons, what types of questions her students asked, and what levels of inquiry she promoted during the lessons. This dataset was important because it enabled me to see what each teacher actually accomplished instead of relying on self report, which can be problematic. The results of this data were combined with the outcomes of the instruments and interviews to give a more complete picture of how the teacher utilized the curriculum.

**Quantitative Data Analysis.** For the quantitative data analysis, I utilized SPSS. The sample sizes in this study were small, two teachers and 23 students for the complete dataset. It was difficult to make inferential arguments with the quantitative data from such small samples, but the data offered valuable information in answering the research questions. The statistics used were descriptive (Leech, Barrett, & Morgan, 2008) and inferential (t-tests).
Several variables may have come into play in this study. Although teacher quality variables, such as content knowledge and experience level, may have influenced the results, I chose to focus on one primary independent variable and two dependent variables. Since the teachers used the same curriculum and were given the same training on its implementation, the individual differences between them was the primary independent variable for this study. The two dependent variables were the students’ posttest scores on the SLA and their scores on the PISCES.

I examined the teachers’ scores on the STEBI, the Inquiry Teaching subscale, and the Materials Checklist and compared the two teachers’ scores to each other at the beginning and end of the study. This enabled me to see similarities and differences between the teachers. I also looked at each teacher’s score on each of these instruments at the beginning of the study and compared it with her score at the end of the study. By doing this, I could determine whether or not differences existed in the teacher’s views after the training and curriculum implementation had occurred.

For the students, I was interested in comparing the two groups of students on the SLA pretest to see if there were significant differences between them at the beginning of the study. I also compared each group’s pretest scores on the SLA with its posttest scores on it. This way I was able to determine whether or not each group improved in its process skills acquisition over the course of the teacher’s implementation of the curriculum. Additionally, it was important to compare the scores between the classes on the PISCES at the end of the study to determine whether or not the teachers’ choices in implementation affected their students’ attitudes towards science.
Basic difference questions can be answered with a t test (Leech, Barrett, & Morgan, 2008), so this statistical method was used to analyze the data. An independent samples t test can be used to compare two different groups of students to determine if a statistical significance exists between the two (Leech, Barrett, & Morgan, 2008). I used this type of t test to see if differences existed between the prestudy SLA scores of Burris Preschool and Wright Preschool. Paired samples t test can be used when two scores are repeated measures, such as a pre and posttest (Leech, Barrett, & Morgan, 2008). I used this type of t test to determine if the students’ pre and post SLA scores from each school increased in statistically significant ways. I also explored the measures of central tendency for all quantitative data collected. By using these statistical methods, I was able to explore how teachers’ pedagogical choices affected their students’ process skills acquisition and attitudes towards science.

**Looking Ahead**

The next two chapters will elaborate upon the results of the data analysis methods presented in this chapter. Chapter Four will focus on the teacher at Burris Preschool and Chapter Five will concentrate on the teacher at Wright Preschool. Each chapter will follow a similar structure, moving through each phase of the study chronologically. Each will present the results of the qualitative and quantitative data analyses. At the end of each chapter, the information will be synthesized, tying together all of the data into an integrated whole.
CHAPTER

IV. CASE STUDY OF MRS. KENNEDY

Structure of the Chapter

This chapter will focus on the data I collected from Mrs. Kennedy and her students. First I will discuss Mrs. Kennedy’s beliefs about science teaching, delving into both qualitative and quantitative data. Both her pretest and posttest scores on the surveys and her interview data will be analyzed. At the end of that section I will compare and contrast her own prestudy and poststudy beliefs about science teaching. After that I will address her beliefs about inquiry as evidenced in her scores on the Inquiry Teaching subscale and her interviews. As in the previous section, I will compare and contrast her beliefs about inquiry using the prestudy and poststudy data.

Following that I will briefly discuss the results of the Materials Checklist to examine the resources Mrs. Kennedy had available to her before curriculum implementation began. I will conclude the first section by discussing Mrs. Kennedy’s beliefs about curriculum as shown in her pre and poststudy interviews. Part of this will include her general views on curriculum implementation and part of it will include her specific opinions on the Young Scientist Series.

The second section of the chapter will include information gathered from the videotaped observations made during the eight weeks of the curriculum implementation. I will focus on the results of the different sections on the Observational Scale. These will include how closely Mrs. Kennedy’s lessons aligned with the prescribed curriculum, the nature of her students’ questions, and the overall levels of inquiry she demonstrated.
In the last section of the chapter, I will examine the student data collected. I will first look at the students’ scores on the SLA prestudy and poststudy. Then I will discuss the students’ PISCES scores and how they compared with Mrs. Kennedy’s views of how her students responded to the curriculum. At the end of the chapter will be a summary of Mrs. Kennedy’s teaching and how her teaching choices affected her students’ learning.

Mrs. Kennedy: Description of the Classroom

Mrs. Kennedy taught four afternoons per week at Burris Elementary School. On Monday and Wednesday afternoons, she taught a preschool class for 4-year-old children. Parents in the preschool were offered a choice of whether to enroll their child for full days or half days, as well as how many days a week they wanted their child to attend. Because of this, the number of students in Mrs. Kennedy’s preschool class varied depending upon the afternoon. She had as few as five students and as many as eight students, depending upon the day. On Tuesday and Thursday afternoons, she taught a Kindergarten Plus program. The children in this program attended the kindergarten at Burris Elementary School in the morning and went to Mrs. Kennedy’s class in the afternoon. Mrs. Kennedy’s Kindergarten Plus class size varied, too, depending upon the day of the week. She had as few as three students or as many as five, depending upon the afternoon. Mrs. Kennedy was the sole teacher for these students in the afternoon.

The physical classroom was of average size. It was not an oversized classroom, as are many early childhood rooms, but more the size of a regular elementary classroom. Please see Figure IV.1 for a diagram of the classroom. It had various posters, calendars,
Figure IV.1 Diagram of Mrs. Kennedy’s Classroom (not to scale).
letters, weather charts, and other items on the walls. There was a television set present. Two long tables were placed end-to-end where the students ate their snacks and completed their work. There was also a kidney-shaped table on one side of the room. In one corner, there was a make-believe area with a castle-like structure and various toys. Although the materials in the classroom were not all new, they were clean and in good condition. The classroom had a comfortable feel to it.

Beliefs

This first section will focus upon Mrs. Kennedy’s views on science teaching, her understanding of inquiry, her materials in the classroom, her beliefs about curriculum, and her opinions about the Young Scientist Series.

Beliefs About Science Teaching I determined Mrs. Kennedy’s beliefs about science teaching with the STEBI instrument and the prestudy interview. Table IV.1 shows each teacher’s scores on the STEBI broken down by subscale. Mrs. Kennedy is Teacher #4 on the table and is highlighted in bold. When the study began, Mrs. Kennedy scored a 50 on the Personal Science Teaching Efficacy Belief (PSTEB) scale, one of the two subscales of the instrument. Compared with the other six teachers who completed this assessment prestudy, she scored second from the highest (along with another teacher with the same score). Her score of 50 out of a possible 65 placed her near the top of the range of 33-52. Her score of 44 on the Science Teaching Outcome Expectancy (STOE) scale fell in the middle of the range of 40-48. Her total score was a 94 out of a possible 125. The totals for the other teachers ranged from 79-97, so she scored second from the top on the STEBI prestudy. Her scores on the STEBI at the beginning of the study
Table IV.1 STEBI Scores for Teachers.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>PSTEB</th>
<th>STOE</th>
<th>Total</th>
<th>PSTEB</th>
<th>STOE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
<td>48</td>
<td>85</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>33</td>
<td>46</td>
<td>79</td>
<td>44</td>
<td>47</td>
<td>91</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>40</td>
<td>90</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>44</td>
<td>94</td>
<td>52</td>
<td>42</td>
<td>94</td>
</tr>
<tr>
<td>5</td>
<td>52</td>
<td>45</td>
<td>97</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>40</td>
<td>80</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>7</td>
<td>44</td>
<td>40</td>
<td>84</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

--Teacher 2 and Teacher 4 were the two fully participating teachers.

--Poststudy data was not collected on Teachers 1, 3, 5, 6, and 7 because these teachers did not participate in the entire study.

Note: Mrs. Kennedy’s scores are Teacher 4.

showed that, compared to the other preschool teachers, she felt confident in her ability to teach science effectively. The only teacher who scored higher than Mrs Kennedy on the STEBI elected not to participate in the study.

Riggs and Enochs (1990) shared means for the STEBI subscales for teachers at different grade levels. The youngest grade level included was kindergarten. Since no data existed for the STEBI with preschool teachers, comparing Mrs. Kennedy’s scores with kindergarten teachers seemed to be the closest match. The mean for 26 kindergarten
teachers on the Personal Science Teaching Efficacy Belief scale was 58.52 (Riggs & Enochs, 1990). Therefore, compared with larger numbers of early childhood teachers, Mrs. Kennedy’s score fell below the mean. The mean for kindergarten teachers on the Science Teaching Outcome Expectancy scale was 48.58 (Riggs & Enochs, 1990). Mrs. Kennedy’s score of 44 on this subscale was also below the mean for kindergarten teachers. Although Mrs. Kennedy scored highly on this instrument compared with her preschool teaching peers who completed this instrument for this study, her scores fell below the mean for a larger number of early childhood educators.

I went through three steps to analyze the pre and poststudy interviews. To start, I completed a constant comparison analysis. For the prestudy interview, I divided the questions into three categories: science instruction, curriculum implementation, and inquiry science. When analyzing her prestudy interview, several themes emerged which I consolidated into emergent theme statements for each of the categories.

After the constant comparative analysis, I completed a domain analysis using the codes derived from the constant comparative analysis. In order to accomplish this, I went through all codes with all nine domains presented by Spradley (1980) presented in Chapter 3: strict inclusion, spatial, cause-effect, rationale, location for action, function, means-end, sequence, and attribution. I used the codes as the included terms, and the categories I developed earlier (science instruction, curriculum implementation, and inquiry science) for the cover terms.

This process helped me with the third step in my qualitative data analysis, a taxonomic analysis. I determined which domains to use in a two-step process. I first looked at the questions I needed to answer and determine which domains answered those
questions most effectively. After that, I examined the number of responses to the domain analysis to see which one yielded the most information. For instance, if there were only five codes that fit a domain and nine codes that fit another, I generally used the domain with nine codes. By looking at both content and quantity, I was able to develop a meaningful taxonomy. I went through this process when analyzing both the prestudy and poststudy interviews.

After I chunked and coded Mrs. Kennedy’s interview transcript for the constant comparative analysis, I consolidated the codes into an emergent theme statement. For detailed examples of how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix L. Here is the emergent theme statement for science instruction:

Science was handled as projects or centers connected to themes, such as tadpoles or geology concepts (mining and panning for gold), where the children read, discussed, and watched to learn. These were huge projects the students loved that fascinated them. Science wasn’t taught as much as it should have been, and she thought they needed to do it more.

Mrs. Kennedy had mentioned to her director that she wanted to look at teaching more science, and her director stated that I would be bringing in a program for them to follow. Mrs. Kennedy was eager to include more science instruction in her day, and she was the only teacher at Burris who was willing to fully commit to the study. This was a volunteer sample of teachers.
Mrs. Kennedy’s poststudy scores on the STEBI did not change much during the course of the study. Her score of 52 on the Personal Science Teaching Efficacy Belief scale was only a slight 2-point increase from her prestudy score of 50. She actually scored lower on the Science Teaching Outcome Expectancy scale, scoring a 42, a 2-point decrease from her prestudy score of 44. When put together, these small fluctuations on the subscales balanced each other out when the total score was computed. Her pre and posttest scores on these subscales were essentially the same when considering measurement error. She scored a 94 on the entire scale poststudy, the same total she scored prestudy.

In terms of the response shifts on the STEBI, after reverse scoring for negatively worded items, three answers moved from a neutral to a positive direction, two answers moved from positive to neutral, one moved from neutral to negative, and 19 stayed the same (whether positive or negative). In terms of the shifts that moved in a more negative direction, there were three (Table IV.2). These were the following questions:

<table>
<thead>
<tr>
<th>Shift of STEBI Items</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree to disagree</td>
<td>0</td>
</tr>
<tr>
<td>Agree to uncertain</td>
<td>2</td>
</tr>
<tr>
<td>Disagree to agree</td>
<td>0</td>
</tr>
<tr>
<td>Uncertain to agree</td>
<td>3</td>
</tr>
<tr>
<td>Uncertain to disagree</td>
<td>1</td>
</tr>
<tr>
<td>Disagree to uncertain</td>
<td>0</td>
</tr>
<tr>
<td>Remained the same</td>
<td>19</td>
</tr>
</tbody>
</table>
• The inadequacy of a student’s science background can be overcome by good teaching. (agree to uncertain)

• Effectiveness in science teaching has little influence on the achievement of students with low motivation. (disagree to uncertain-negatively scored item)

• The low science achievement of some students cannot generally be blamed on their teacher. (uncertain to disagree)

All of these items somehow relate to a belief that good teaching can overcome students’ limitations, and after the study Mrs. Kennedy did not feel so confident that good teaching can achieve this. In later sections, I will discuss the lack of engagement of some of her students. It could be that she took that lack of engagement personally, as she was a teacher who went to great lengths to plan and implement her lessons. This response in a couple of her students might have caused her to doubt herself more at the end of the study than at the beginning.

Beliefs About Inquiry  Mrs. Kennedy’s beliefs about inquiry also did not shift noticeably during the course of this study. When she originally completed the Inquiry Teaching subscale, she scored a 67 out of a possible 76. The range for the six teachers who fully completed this subscale at the beginning of the study was 50 to 69. Mrs. Kennedy’s score was the second from the highest. Out of the four possible responses (strongly disagree, disagree, agree, and strongly agree), she gave a strongly agree response to 10 items after rescoring negatively worded items and an agree response to 9 items. Every answer she gave on the pretest was positive; a majority were very positive.
Mrs. Kennedy was a teacher who had very positive feelings about inquiry as evidenced in her Inquiry Teaching subscale score prestudy.

Mrs. Kennedy’s prestudy interview reflected a teacher who had a basic understanding of inquiry teaching. When asked what inquiry science means, she responded with the following statement:

Inquiry is asking questions. So to me it would be inquiry science is where the kids are enthused enough to ask a lot of questions as to what’s next and what happens after that. And what happens, you know. How does it begin, middle, and end. That’s what I would say inquiry science is (J. Kennedy, personal communication, September 2011).

I then developed a taxonomic analysis for each category (see Appendix M for the domain analysis that preceded the taxonomic analysis). The taxonomic analysis for the inquiry teaching category used the attribution domain and is shown in Figure IV.2.

Mrs. Kennedy held positive views of inquiry at the beginning of the study as evidenced by her score on the Inquiry Teaching subscale. She answered all questions on the prestudy assessment positively. Her interview answers about inquiry were brief, but compatible with what inquiry science is. Mrs. Kennedy’s poststudy scores on the Inquiry Teaching subscale actually decreased during the course of the study. Her total score on the measure poststudy was a 60, so her score went down 7 points. Possible explanations for this decrease will be presented at the end of this section.

The poststudy interview was analyzed in the same manner as the prestudy interview. After completing the constant comparative analysis, I wrote an emergent theme statement that synthesized the interview information. For detailed examples of
Figure IV.2 Taxonomic Analysis of Mrs. Kennedy’s Views of Inquiry Prestudy.

how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix N. This statement is the following:

Inquiry science entails finding out the students’ questions and doing experiments to find the answers to them.

At the beginning of the study, Mrs. Kennedy had very positive beliefs about inquiry. She answered all questions on the Inquiry Teaching subscale with an agree or strongly agree response. After the study was completed, Mrs. Kennedy still maintained her positive views of inquiry. She still answered all questions with an agree or strongly agree response. Many of her responses, however, shifted to become less extreme. For instance, she answered 10 items on the pretest with a strongly agree response, and only 3 on the posttest with a strongly agree response. It appeared that her views on inquiry, while still positive, were not as positive as when the study began.

The taxonomic analysis of Mrs. Kennedy’s poststudy understanding of inquiry science was similar to what she had stated at the beginning of the study. Figure IV.3
shows the poststudy taxonomic analysis. She did move from saying that in inquiry science, the children “ask a lot of questions as to what’s next and what happens after that. And what happens, you know, how does it begin, middle, and end” (J. Kennedy, personal communication, September 2011) prestudy to stating the children “would do experiments to find out the answer to their questions” (J. Kennedy, personal communication, December 2011) poststudy. It would appear that she refined her definition of inquiry to include experiments, but her basic definition did not appear to change much beyond that.

It is difficult to know why Mrs. Kennedy’s views of inquiry teaching moved in a less positive direction. One possible explanation is that Mrs. Kennedy knew more about inquiry when the study concluded. She knew the challenges of creating an inquiry-based classroom environment. Perhaps she saw more realistically the time and effort a teacher has to put forth in order to fulfill this teaching goal. Sometimes when a person has more knowledge or information on a topic, what the person does not know becomes amplified. To use a quote attributed to Aristotle, “The more you know, the more you know you don’t know” (Philosophers, 1998-2012). It was possible that Mrs. Kennedy had a deeper knowledge of inquiry teaching and realized that she might not have been using inquiry techniques in her own instruction. This could be supported by her statement during the poststudy interview when she stated the following:

So doing the open was harder for me because I’m used to having a lesson plan. And, uh, and I still did that to a certain extent, I think. You probably saw me do that. But, um, I think probably in the process, the open is probably the best
Figure IV.3 Taxonomic Analysis of Mrs. Kennedy’s View on Inquiry Science Poststudy.

because you’re really hitting on their interest not what I’m thinking their interest might be, so I think I switch probably learning to do more open. And I still need to learn more. Because I still try and structure somewhat of a lesson plan (J. Kennedy, personal communication, December 2011).

This statement reflects that Mrs. Kennedy’s need for a more structured lesson plan might have been at odds with what she knew the students needed. She acknowledged that she still needed to continue her own learning.

Mrs. Kennedy was more comfortable with structured lessons, as reflected in her observations and her interviews. The Young Scientist Series lessons, while they offer a basic framework, do not give a specific script for the teacher to follow. Mrs. Kennedy
might have felt more comfortable teaching with a curriculum that offered her more structure. Had she done that, she might have maintained the more positive views of inquiry instruction she held at the beginning of the study. Although she made positive comments about the curriculum, it might not have been an ideal “fit” for her teaching style.

**Materials Checklist** In his study on the preschool science environment, Tsunghui (2006) found that half of all preschool classrooms had a science area available and most of the science areas were placed near a window. Mrs. Kennedy’s classroom illustrated this finding. Her science area was located on a ledge by the window of the classroom. During the course of the study, the mealworms, snails, and crickets all found a home there. Mrs. Kennedy also had many science materials available to her at the beginning of the study.

Of the six teachers who completed the Materials Checklist at the outset of the study, Mrs. Kennedy scored availability of materials 39, the highest score. On the Science Materials subscale, she scored a 13, which was at the top of the range of 7-13. She had an aquarium, books, flashlights, living animals, magnets, magnifying glasses, planting materials, plants, posters/charts, puzzles, a sensory table, and videotapes/DVDs. Most notably, she had an outdoor garden available to her right on the Burris Elementary School grounds.

On the Science Equipment subscale, she scored the highest of all of the teachers, with a 17 on a range of 10-17. She noted that she had candles, cardboard tubes, egg cartons, flower pots, food coloring, measuring cups and spoons, milk cartons, old sheets
and pillowcases, pitchers, plastic jars and containers, potting soil, rulers, small cages, sponges, spools, tape measures, and yarn.

Mrs. Kennedy’s score on the Natural Materials subscale was a 9, which was again at the top of the range of 3-9. She checked every item on that subscale, showing that she had access to bird’s nests, dried flowers, feathers, fossils, gourds, insects, nuts and seeds, pine cones, plants, and seashells.

Mrs. Kennedy’s total score on this instrument was a 39, the highest of all of the teachers, who ranged from 20-39. An interesting observation was that Mrs. Kennedy shared a classroom with another teacher who completed the Materials Checklist, and she scored higher than that teacher. That teacher scored a 20 even though she shared the same physical space as Mrs. Kennedy. The fact that that teacher scored at the lowest of the range and Mrs. Kennedy scored at the highest of the range, even though they both shared the same room, was very interesting. Either Mrs. Kennedy completed the questionnaire more carefully, she was more aware of the materials they had, or she checked items not in the immediate classroom to which she had access. The differences in the scores for Mrs. Kennedy and the teacher who shared her room also raised concerns about the validity of the checklist. When I looked at validity information on this instrument, I could not find any in the article written by Tsunghui (2006). Because of this lack of validity, information gathered from this measure should be viewed as exploratory in nature.

It is interesting to note that Mrs. Kennedy, even if she did not have science materials at hand, worked hard to bring in materials she needed. For instance, she brought in different types of seeds for the children to observe and taste and she brought in a pumpkin for each child to investigate. Her commitment to providing her students with
hands-on, authentic science materials may have explained why her score was so high on the Materials Checklist. Mrs. Kennedy had many materials available to her so that she could teach science effectively.

Beliefs About Curriculum Mrs. Kennedy’s beliefs about curriculum were derived from her pre and poststudy interviews. For detailed examples of how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix O. After the constant comparative analysis, I consolidated the codes into an emergent theme statement:

This teacher does well if she has time to see how the curriculum flows and can envision how to go about it. She considers if the activities are a good fit for her kids, considering what they can grasp, their fine motor skills, attention spans, and levels of learning. She divides the children by age and adjusts the curriculum to fit their needs, often connecting it to their theme to provide continuity. She tends to follow a curriculum closely at first, adjusting it as time goes on.

Mrs. Kennedy’s views of curriculum were a balance of what she knew she needed and what she felt her students needed. She acknowledged her own need to familiarize herself with a new curriculum before starting to use it. She often talked about wanting to “see how it’s going to go” (J. Kennedy, personal communication, September 2011) in order to feel comfortable teaching from it. At the same time, though, Mrs. Kennedy considered her own unique groups of children, wanting to make sure the curriculum fit their needs, too.

Beliefs About The Young Scientist Series When the curriculum implementation ended I asked Mrs. Kennedy to share her views on the Young Scientist Series curriculum.
For detailed examples of how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix P. The following is an emergent theme statement which synthesized her views on the strengths of the curriculum:

She thought the hands-on nature of the curriculum was its greatest strength. The students got to hold the animals, talk about them, pretend to be them, write about them, watch and observe them, and conduct experiments about them. She thought it was great, and she loved it.

I also asked Mrs. Kennedy about the weaknesses of the curriculum. She shared mostly positive comments, but stated the following: She loved the curriculum because it taught the students to think. She would probably shorten the Open Exploration and move to the Focused Exploration sooner.

Mrs. Kennedy’s comments about moving to the Focused Exploration phase sooner were interesting. They strongly triangulated what I observed and noted during the curriculum implementation phase of the study. Although I had suggested that the teachers spend four weeks on Open Exploration, Mrs. Kennedy only spent three weeks on it. She moved through the steps of the Open Exploration very quickly. For instance, although there were four separate steps in the Open Exploration, Mrs. Kennedy combined the first three steps into only one. Although her prestudy score on the Inquiry Teaching subscale indicated that she valued inquiry, she did not spend as much time on the different steps to promote a deeper understanding of the concepts. The fact that Mrs. Kennedy realized that she moved through the Open Exploration quickly and acknowledged it showed that she was a thoughtful teacher with a strong awareness of what she was doing in the classroom.
Observational Scale

During this study, I formally observed Mrs. Kennedy once a week for a total of eight observations. Each observation was videotaped. I completed the Observational Scale afterwards. It was challenging to gather all of the information needed on the form in one viewing, so I watched each DVD two times. For the first viewing, I took notes on the general flow of the lesson and transcribed student questions. When I watched the second time, I focused more on listening for the students’ questions. I transcribed these to determine in which category to place them, *procedural* or *curiosity*. After I completed the second viewing I completed the Observational Scale. Table IV.3 illustrates the information I gathered regarding the curriculum implementation process for Mrs. Kennedy.

When looking at Mrs. Kennedy’s adherence to the curriculum, her largest numbers of observable actions were in attempts. On the Observation Scale, attempts were defined as whether or not the teacher tried to include each step in the lessons. These were followed by omissions (leaving out content in a step) and to a lesser extent additions (new material not suggested in the curriculum) and changes (rewording of material) (Ringwalt et al., 2010). I will now go through each category of the Curriculum Implementation subscale of the Observational Scales and discuss how closely Mrs. Kennedy adhered to the curriculum. My focus will be on the ways she deviated from the lesson plans, so I will discuss her omissions, additions, changes, and new methods.

Mrs. Kennedy sometimes changed the curriculum by altering the order in which she went through the steps. For instance, for the first lesson, she brought out worms at
Table IV.3  Mrs. Kennedy’s Observational Data.

<table>
<thead>
<tr>
<th></th>
<th>Lesson Number</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<td></td>
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<td></td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1.25</td>
</tr>
</tbody>
</table>

the end of the lesson instead of the beginning. She often handled safety and animal respect issues as they arose outside instead of discussing them prior to the students going out. She also changed the way she documented students’ responses. One observation record in the *Young Scientist Series* was a simple one. It gave the teacher lines to record the teacher’s name, the date, the setting, whether or not it was Open or Focused Exploration, whether or not the topic was plants or animals, and the step in the curriculum the teacher was covering. It also provided a grid with a place to write individual student’s names and a column labeled “Seen and Heard” (Chalufour & Worth, 2003, p. 143). Instead of using this form in the *Young Scientist Series* teachers’ guide, Mrs. Kennedy simply recorded the children’s questions with her own format, writing their names and questions on a regular piece of paper. The information she recorded on
her own paper was very similar to the information one would record on the observation form in the book.

Another way Mrs. Kennedy changed the lessons was the way she handled tools and resources. Sometimes she gave the students materials without explicitly discussing their use. During the second lesson she gave the students their naturalist kits, but she did not talk about the individual tools in the kit and their uses. Other times she used the posters I had provided to the class to talk about the animals’ parts or life cycles, instead of books as the curriculum guide had recommended. The *Young Scientist Series* recommended using posters about living things in the classroom (Chalufour & Worth, 2003), so I included posters in the materials I gave each teacher.

For the last lesson, Mrs. Kennedy made some interesting changes to the lesson because the ants that had been ordered had not yet arrived. She put sand on the table and had the children use pencils to pretend they were ants crawling into the ant hole. She also gave them nuts and had them pretend the nuts were ants. The children arranged these in patterns of how they thought the ants would move. On that lesson, she provided the students with coloring sheets of ants and anteaters. So instead of exploring and observing actual ants, she planned these activities. Although these were changes to the lesson, they were innovative ways to prepare the children for the arrival of the ants and get them thinking about how ants behave.

Mrs. Kennedy omitted components of the lessons as well. At the beginning of the study, she did not record the students’ questions and reactions to the explorations on the sheets and documentation panels listed in the curriculum. According to the observation forms, I did not witness her writing student responses on chart paper. I did see mini-
posters she had made displayed on the bulletin board, however. Some of these appeared to be students’ responses, so I do think this occurred even though I did not see it.

Mrs. Kennedy had the students record their observations through drawings during some lessons, but this did not happen consistently. She also sometimes omitted the opportunity to help the children refine their drawings by asking specific questions about the animals.

There were times when Mrs. Kennedy omitted the sections of the curriculum involving helping the students compare and contrast living things. She did not have them compare themselves to the small animals or compare the photographs in field guides to the small animals. Although she did have the children move like the mealworms in one lesson, she did not have them do this with all of the small animals they investigated.

In the first two lessons, certain discussion topics were omitted. For instance, the summary discussion at the end of the lesson did not occur. Also, although she sometimes discussed respect for the animals in a different part of the lesson (as mentioned in the above section on changes), she did not address this topic in three of her lessons at all. At times the lessons called for the students to make predictions, discuss their prior knowledge, and describe the places they would find animals. These discussions were absent from the lessons, too.

There were opportunities for the children to use hand lenses to observe the small animals more closely, but Mrs. Kennedy did not get these out during three lessons as suggested. There was one time she did not give the students the naturalist kits during the lesson at all.
Once the weather got colder, Mrs. Kennedy did not take the children outside for observations. She collected many resources to bring the outside in, however. These resources will be discussed in further detail in the next section about additions.

Mrs. Kennedy made many interesting additions to the lessons. At times, she had the children engage in an activity for the second time. For instance, in the first lesson, she had the students go outside a second time to return a small animal to its home.

Other times she introduced material meant for later lessons at an earlier time. She discussed the terrarium and the naturalist kits during the first lesson, when there were subsequent lessons specifically designed to present them. The second lesson was largely concerned with setting up the terrarium. At the beginning of that lesson, the students were already discussing what they had placed inside the terrarium and watering it. Mrs. Kennedy also introduced specific content in some of her lessons that was not explicitly intended for those lessons. For instance, she talked about insect body parts and life cycles on many occasions.

Many times Mrs. Kennedy gathered materials to help the children have a hands-on experience. She brought in different types of seeds to observe and taste, pumpkins to explore, wasps to examine, and a wasp nest to observe. She also created mini-posters to share with the students regarding the life cycles of the different small animals. She referred to these in four different lessons.

Mrs. Kennedy introduced books about the different kinds of small animals and allotted time for the students to read them. Three of her lessons ended with the students reading science books on the floor. Many of the students seemed to enjoy this time of free reading about science topics.
When the students were learning about the crickets, Mrs. Kennedy created puzzles of the different cricket body parts for the children to assemble. She cut the parts out of different colors of construction paper and put them in baggies for each group of two or three children. The children assembled them on the floor before drawing the crickets back at their tables. These puzzles may have increased the children’s awareness of the crickets’ anatomy before they drew them.

Mrs. Kennedy also added the sand pile to her final lesson to represent an anthill, as discussed earlier. Although this decision was made because the ants had not arrived, the activity helped the students think about how ants behave, which helped set the stage for the later learning that would occur.

Mrs. Kennedy altered the lessons in the Young Scientist Series in several ways. The largest occurrences of curriculum modifications were omissions to the lessons regarding documentation, use of science tools, opportunities to compare and contrast, discussion topics, and remaining in the classroom instead of going outside in colder weather. She also added her own ideas to the lessons in smaller numbers. In this area, she brought in many of her own resources (puzzles, books, wasp nests, pumpkins, seeds) and covered content not specifically addressed in the curriculum. Of all of the types of modifications, she made changes to the curriculum least of all. These few changes she made were related to the order of the lessons, documentation methods, and use of science tools. While Mrs. Kennedy followed the basic structure of the Young Scientist Series curriculum, she did not follow it to the letter, but altered lessons depending upon her comfort level and her students’ interests.
Decisions Made  Many teacher decisions had to be made during the course of this study. Mrs. Kennedy had to determine when to schedule the lessons, when to move from Open to Focused Explorations, which topic to teach in Focused Exploration, and what specific topics to cover during the Focused Exploration.

Scheduling. Because Mrs. Kennedy taught in the afternoon, she did not have as many constraints about teaching specific content. The morning teachers covered the academic topics such as reading and writing. She had more flexibility about scheduling in the time periods this study required, and she had the support of her director in doing so. Mrs. Kennedy allotted 45 minutes every afternoon to teach science to her students. Since she had preschoolers two afternoons per week and kindergartners two afternoons per week, each child fully enrolled in the program received two 45-minute science lessons per week. On Monday and Tuesday afternoons, she taught the same lesson. On Mondays the preschoolers would experience the lesson, and on Tuesdays the kindergartners would experience it. Then she did the same rotation on Wednesday and Thursday. On Wednesday the preschoolers would receive the second science lesson, and on Thursday the kindergartners would receive it. I observed her lessons with both groups of students, and I did not notice differences in the way she delivered the lessons to the two age groups.

In my observations, Mrs. Kennedy was very consistent about maintaining her schedule. She worked very hard to adhere to the time parameters of the study, teaching two 45-minute science lessons each week. Even when I observed her lessons on Wednesdays or Thursdays, it was evident she had taught the Monday/Tuesday lessons. On at least two occasions she brought out a paper on which she had written the students’
questions generated during the previous lesson in order to help them figure out how to answer them. She also placed little posters and observations on her science bulletin board that I realized had been covered when I was not there. I was confident that the students were receiving the science instruction even when I was not there to observe. She was very systematic in her scheduling.

**Student Choice.** Mrs. Kennedy did not usually give the students a choice about whether or not to participate in the science activities, at least at the beginning of her lessons. She had a definite structure to her science plans, and she expected the students to participate in the different aspects of the lesson. There were several occasions when students were interested in free play. While Mrs. Kennedy encouraged them to stick with the science lesson, she did not force them to do so. In the curriculum guide, it states, “Spend time with those children who are ready to look for and observe living things. Do not push those who are not engaged” (Chalufour & Worth, 2003, p. 117). At the end of two of her lessons, some children were still engaged in the science topic while others were playing in the make-believe area. In the *Exploring Nature with Young Children Teachers’ Guide*, the authors give a picture of what the children are doing during the science explorations. They state the following:

As children move into the open exploration, some will be immediately excited by the ideas and challenges. Others will be more reluctant, perhaps observing a plant or animal for a minute or so before moving onto another activities. Still others will prefer to play on the swings or choose a different activity (Chalufour & Worth, 2003, p. 117).
Mrs. Kennedy realized that the curriculum supported the children’s choice in participation, so she felt justified in allowing her students to go play or stay with the science materials.

**How Soon to Move From Open Exploration to Focused Exploration.** At the beginning of the study, we established a timeline of spending four weeks on Open Exploration and four weeks on Focused Exploration. Mrs. Kennedy often combined several lessons into one, which caused her to move through the Open Exploration phase more quickly. For instance, in the first lesson, she discussed the terrarium and the science tools, which had entire lessons specifically devoted to them. This caused her to move to the Focused Exploration by the fourth week of the study because she was ready to do so.

This decision was expressed in Mrs. Kennedy’s interviews. She mentioned that she was more comfortable with the Focused Exploration:

The only thing I would probably do differently is go straight to the focused piece. I like that so much. Because it really taught them how to think better rather than me feeding it to them. And I think for a young scientist that’s probably the good way to start. So that’s maybe I’d shorten the first piece and go straight to the focused (J. Kennedy, personal communication, December 2011).

Perhaps she did not realize how quickly she moved from the Open Exploration to the Focused Exploration, as her comments above show that she might have moved even more quickly to the Focused Exploration than she did, if given a choice. She did acknowledge that the Open Exploration was harder for her:
I’m used to doing structured. So doing the open was harder for me because I’m used to having a lesson plan. And I still did that to a certain extent, I think. You probably saw me do that. But I think probably in the process, the open is probably the best because you’re really hitting on their interest not what I’m thinking their interest might be, so I think I switch probably, learning how to do more open. And I still need to learn more. Because I still try and structure somewhat of a lesson plan. I want to see how it goes. I have a thought in my head about how it’s gonna go, and that’s not the way this should go. I should do more their interest, follow that, and stick to it for two, probably two meetings with them (J. Kennedy, personal communication, December 2011).

I felt that Mrs. Kennedy’s above statement was very self-reflective. Her lessons were more structured on the inquiry teaching continuum, and she realized it. While she commented that she would move more quickly to the focused, as she talked more she started to realize that there might have been value in the Open Exploration phase she had not considered before. It was very self-revealing.

**Focused Exploration: Plants or Animals.** When she had finished the Open Exploration phase, Mrs. Kennedy had to choose whether or not to study plants or animals for the Focused Exploration. During week four of the study, I gave the students an informal interest survey to determine their preferences. At that point, Mrs. Kennedy had already decided that she would study animals in the Focused Exploration. I informally asked her at the time what made her decide that, and she stated that the students had seemed more interested when they had looked at the animals.
I administered the Preschool Student Interest Assessment to eight of Mrs. Kennedy’s students. Of the eight students, seven wanted to learn more about animals (88%), while only one wanted to learn more about plants (13%). These results confirmed what Mrs. Kennedy intuitively knew: Her students were more interested in animals. When I asked her to elaborate on her decision in her poststudy interview, she stated the following:

It’s interest level. The kids because the first part we had done seeds and leaves. That was a huge interest to them. But whenever we found a worm or roly-poly or something like that, they just lit up. So I thought for this group, the animal part would hold their interest longer (J. Kennedy, personal communication, December 2011).

**What to Cover During Focused Exploration.** During Focused Exploration, the class begins by searching for animals, making a home for visiting animals, observing the animals up close, and then moving on to a more content-based focus. Some of the choices of content are focusing on animals’ body parts, behavior, and/or life cycles.

Mrs. Kennedy did not teach the lessons concerned with searching for animals or making a home for visiting animals because I had given her the small animals, their habitats, and what they needed to stay alive. During the Focused Exploration I provided the class with mealworms, water snails, crickets, ants, and their habitats. I think that Mrs. Kennedy did not cover this aspect of the curriculum because it had already been done. She moved directly into observing the animals up close and continued in that step for the remainder of the study.
Mrs. Kennedy did address the animals’ body parts, behavior, and life cycles in her lessons, but they were brought into each lesson all at once. For instance, when she taught a lesson about the mealworms, she talked about the parts of the mealworm and the life cycle of the mealworm. Instead of allocating more time to delve deeper into the study, she presented a lot of content at once and moved on to learn about another animal.

While she did talk with the children about experiments, she did these fairly quickly. When the students were trying to see whether or not crickets jumped or flew, they put them down on the ground and observed them jumping. They then concluded that they jumped. None of the experiments seemed to take place over the course of several lessons. Sometimes Mrs. Kennedy would go to a book and read the answer to a child’s question instead of devising an experiment to figure it out. This method seemed to contradict what the Inquiry Teaching subscale and interviews revealed about her views on inquiry, that she valued it. I did feel like she tried to include that experimental phase of inquiry in her lessons, but those experiments did not take very long.

**Student Questions**  
During the observed lessons, I wrote down the students’ questions and then categorized them according to whether or not they asked *procedural* questions or *curiosity* questions. Although I wrote down the questions on the first viewing of the videotape, I found that I was able to hear many more questions when I listened a second time. Because Mrs. Kennedy’s classes were so small and she taught the science lessons to the whole group, I believed that I was able to hear most of the students’ questions clearly. I did add the category on the scale of *unknown* to my original categorization of questions.
<table>
<thead>
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<td>16</td>
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<td>1</td>
<td>20</td>
<td>2.5</td>
<td>7</td>
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</table>

Table IV.4 shows the breakdown of the students’ questions during the eight lessons I observed. The following are some examples of questions categorized as procedural:

- Will I have a magnifying glass?
- Where’s my bucket?
- Can you help me?

Examples of curiosity questions are as follows:

- Now where can I find a bug?
- Do you want to touch him?
- Where did you find that?

The last category, with examples of questions marked as unknown, as listed below:

- What the heck?
- Hey, guess what?
A majority of the questions asked were procedural (58%), some were curiosity (35%), and a small number were unknown (7%). It is interesting to note that in lessons 5, 6, and 8, the curiosity questions outnumbered the procedural ones. One note that was not reflected on the observation forms was who asked the questions. There was one student in Mrs. Kennedy’s preschool class who asked many curiosity questions. Having one student like that can influence the outcome of the percentages.

**Overall Levels of Inquiry** When I originally created the Observational Scale, I included two different measures of the level of inquiry used. The first was a rubric developed by Fay and Bretz (2008) that looked at three aspects of a lesson, the problem/question, the procedure/method, and the solution. It looked at varying levels of student and teacher involvement in those three processes. For instance, a level 0 would be a lesson in which the problem/question, the procedure/method, and the solution were all provided to the student by the teacher. A level 3 would be a lesson where the problem/question, the procedure/method, and the solution were all constructed by the student. Levels 1 and 2 both show a combination of teacher and student involvement, with a level 1 showing higher teacher involvement and a level 2 showing higher student involvement. Before beginning the study I was not sure whether or not a preschool curriculum would have this level of specificity in terms of exploring a problem. Because of that, I also included another measure of the level of inquiry.

My second measure of inquiry utilized three levels of inquiry defined by Yager et al. (2005), structured inquiry, guided inquiry, and full inquiry. My goal was to look at the overall lesson and determine which level most characterized the lesson as a whole.
Table IV.5 Levels of Inquiry in Mrs. Kennedy’s Lessons.

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<tr>
<td>Overall Level</td>
<td>S</td>
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</table>

*Note: O=open inquiry, G=guided inquiry, S=structured inquiry

Table IV.5 reflects the breakdown of levels of inquiry for Mrs. Kennedy’s science lessons. On the numbered scale, three scored a 0 and five scored a 1. In terms of the overall levels of inquiry, a majority of Mrs. Kennedy’s lessons fell in the structured inquiry (5 ½ lessons) category. Although 2 ½ of her lessons utilized guided inquiry, none of the lessons used open inquiry. For one lesson, the outside portion of the lesson fell into the guided inquiry category, while the inside portion fell into the structured inquiry category. This was the reason why was one lesson was divided in half. Often Mrs. Kennedy had the students generate the problems/questions, but she told them the procedures/methods and solutions most of the time. The overall level of inquiry did support the numbered rubric, because a majority of her lessons were structured and scored a 0 or 1 on the rubric. Usually Mrs. Kennedy did not focus on only one question during her lessons, but explored a variety of questions quickly. Although that might have altered the level of inquiry had she handled each question differently, she usually was consistent in how she tried to answer the questions.
Connections Between Levels of Inquiry and Prestudy Attitudes on STEBI, Inquiry Teaching Subscale, and Materials Checklist  Mrs. Kennedy began the study with the second from the highest score on the STEBI. Her Inquiry Teaching subscale score was also second from the highest of the teachers who completed it prestudy. Additionally, she felt she had the resources she needed in order to teach science effectively.

Mrs. Kennedy seemed to be confident in her ability to teach science during this study. She was a teacher with a love of science who wanted to prioritize it in her classroom. While she worked hard to document student questions and try to figure out the answers to them, her activities were often teacher-led. Her interviews showed that she felt comfortable with a definite lesson plan. It may be that the Young Scientist Series did not offer her enough structure. She made positive comments about the curriculum, but I wonder if she was reluctant to be critical to me because we had developed a comfortable rapport. This could be viewed as reactivity, which Onwuegbuzie and Leech defined as “changes in persons’ responses that result from being cognizant of the fact that one is participating in a research investigation” (Onwuegbuzie & Leech, 2007, p. 236). That is one limitation in being so present for a study. Teachers may filter their comments so that the researcher will feel that it was successful.

Student Data  The student data consisted of pre and posttest scores on the SLA and posttest scores on the PISCES. I also gathered qualitative data by asking the teachers to describe their students’ responses to the curriculum in the poststudy interview. Since Mrs. Kennedy followed the same lesson plan format with her two different small groups of students, I have combined her student data into one group.
### Table IV.6 Descriptive Statistics Burris Preschool SLA Pretest and Posttest.

**Descriptive Statistics**

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<td>Valid N (listwise)</td>
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</tbody>
</table>

![Graph](image.png)

**Figure IV.4** The SLA Pretest Total Distribution (with the curve of the normal distribution shown).
Pre and Post SLA. Because of the timing of consent/assent form returns, I collected data for different numbers of students for the various assessments. For clarity, in this section I will only include data from the students for which I have both pre and posttest data on the SLA. Table IV.6 shows the basic descriptive statistics for the pre and posttests. Figures IV.4 and IV.5 provide the distributions of scores on the pre SLA.
(Figure IV.4) and the post SLA (Figure IV.5). I used the SPSS program to run statistics on the student assessments.

In order to see if there was a statistically significant increase between the SLA Pretest and SLA Posttest, I ran a paired samples t test. The p-value of .689 showed that the differences between the pre and posttest scores were not statistically significant. The difference between pre and posttest scores was likely due to chance.

Looking at the descriptive statistics (Table IV.6), the students’ means slightly increased from the SLA pretest to the SLA posttest, but that mean increase was not statistically significant. One possible explanation for this may be the fact that Mrs. Kennedy moved quickly from the Open to the Focused Exploration. Her lessons had a strong content basis. The lessons were structured and did not allow as much time for free exploration, which would have enabled the students to hone their process skills. It is also important to note that the sample size for her students was low. Only seven students completed both the SLA pre and posttests. Given the small number of students, it would have taken a large difference in the mean to produce a statistically significant result on the t test. Other possibilities also exist which be discussed in Chapter 6 when a comparison between the Wright Preschool and Burris Preschool occurs.

**PISCES** The PISCES assessment was given to the students at the end of the study to determine their attitudes towards science. This assessment was not given as a pretest. I felt that preschool children would not really know what the word *science* meant before the curriculum was used with them. Mantzicopoulos et al. (2007) found that when children start kindergarten, only a few of them have knowledge of science events and activities. Since the children in this study were even younger than kindergarten, I did not
Figure IV.6 The PISCES Total Distribution (with the curve of the normal distribution shown).

want to confuse them or cause them anxiety. Since all of the questions on the PISCES used the word science, I thought it better to administer this at the end when the children had a better sense of what science is. Even though I could not compare pre and posttest scores for the same group of children, I looked at trends in the distributions and compared the students’ scores from the two schools. Figure IV.6 shows the distribution of scores of the students from Burris Preschool and Table IV.7 shows the descriptive statistics.
Along with the PISCES quantitative scale, I also asked Mrs. Kennedy about how her students responded to the science lessons. By addressing this in the qualitative interview, I could triangulate my findings regarding the students’ attitudes towards science. Mrs. Kennedy indicated that her students responded positively to the lessons. After chunking and coding the data from the interview (for more detail, please see Appendix Q), the emergent theme statement on this topic is as follows:

Most of the students loved the lessons. They loved figuring things out for themselves, and now they know a lot about insects.

Although I did not score the students on engagement during the lessons I observed, I noticed that there were times when some of the students became disinterested
in the lessons and wanted to do other activities, such as play. Mrs. Kennedy was aware of this, as she stated the following in the poststudy interview:

I saw some of them start losing, in this class start losing interest, so I’d like to just try and bring them back somehow (J. Kennedy, personal communication, December 2011).

Although the students seemed to enjoy the lessons for the most part, the PISCES and teacher interview showed that their attitudes towards science were not overwhelmingly positive.

Conclusion

Mrs. Kennedy was a teacher with a strong commitment to science as a subject. She started the study with positive attitudes towards science and inquiry teaching. Her results on the Materials Checklist showed a teacher who had science resources available to her, and she scored the highest of all of the teachers on this measure. She was positive about using the Young Scientist Series and allocated distinct times when she would teach from it.

When Mrs. Kennedy taught the curriculum she made many choices about how to implement it. She made more attempts to follow the curriculum than not. This number was followed by a large number of omissions. Her omissions were largely related to documentation, science tools, comparisons, discussion topics, and outside exploration. She included additions, changes, and new methods in smaller numbers. Mrs. Kennedy spent three weeks on the Open Exploration phase, moving on to study animals for the Focused Exploration. When she taught the Focused Exploration, she included several
kinds of small animals. She covered content, such as animal behavior, body parts, and life cycles, but often discussed all of these topics during the same lesson.

Mrs. Kennedy incorporated inquiry into her lessons. However, a majority of her lessons were teacher-directed. Occasionally she took the students’ lead in terms of what they investigated, but the inquiry process was never completely determined by the students. This was likely due to her personal comfort level with having a more structured lesson plan. In terms of the overall level of inquiry of her lessons, a majority were structured inquiry and the rest were guided inquiry. Her interview results supported this finding.

The student data from Mrs. Kennedy’s students reflected that there was no statistically significant increase on their science process skills from the beginning of the study to the end. Some of the students seemed to lose their engagement near the end of the study, and Mrs. Kennedy recognized this and reflected upon it.

Mrs. Kennedy enjoyed science, cared about her students, and felt most comfortable with structured lesson plans. She followed the lesson ideas more than she omitted them. She took the curriculum and made it work in a way that was comfortable for her. While the use of the curriculum did not show noticeable changes in Mrs. Kennedy’s views on science and inquiry teaching, her interviews revealed more information. She reflected upon her own teaching style and how that affected her choices. She became more self-aware and was already thinking of ways she could engage all of the children and become more comfortable with Open Exploration. These thoughts of hers will likely result in stronger science instruction.
CHAPTER

V. CASE STUDY OF MRS. BENEDICT

Structure of the Chapter

This chapter will present the data I collected from Mrs. Benedict and her students. First I will focus on Mrs. Benedict’s beliefs about science teaching, examining both qualitative and quantitative data. Both her pretest and posttest scores on the surveys and her interview data will be discussed. Then I will compare and contrast her beliefs about science teaching both prestudy and poststudy. At the end of that section I will address her beliefs about inquiry as shown on her scores on the Inquiry Teaching subscale and the interviews. I will compare and contrast her beliefs about inquiry, incorporating the prestudy and poststudy data into my discussion.

I will then share the results of the Materials Checklist to determine the resources Mrs. Benedict had available before the curriculum implementation began. I will finish the first section by discussing Mrs. Benedict’s beliefs about curriculum, presenting the information gathered in her pre and poststudy interviews. Her general views on curriculum implementation and her specific opinions on the Young Scientist Series will both be considered.

The second section of the chapter will present information collected from the videotaped observations made during the eight weeks of the curriculum implementation. I will include the results of the different sections on the Observational Scale. These will examine how closely Mrs. Benedict’s lessons followed the prescribed curriculum, the
types of questions her students asked, and the levels of inquiry she incorporated in her lessons.

For the final section, I will explore the student data collected from the SLA prestudy and poststudy. Then I will share the students’ PISCES scores and examine how they compared with Mrs. Benedict’s views of her students’ responses to the *Young Scientist Series*. I will conclude the chapter with a summary of Mrs. Benedict’s teaching and how her teaching choices affected her students’ learning.

**Mrs. Benedict: Description of the Classroom**

Mrs. Benedict taught preschool full time at Wright Elementary School. The preschool students who attended for the full day began school at 8:36 a.m. and ended at 3:13 p.m. Because parents were offered a choice of whether to enroll their children for full days or half days, the number of students in the classroom varied depending upon the day of the week and the time of day. The largest number of students in the classroom at any one time was 24. Mrs. Benedict shared the teaching responsibilities with another teacher, so there were a minimum of two teachers in the classroom at all times. A third teacher assisted them for 4½ hours per day between 10:00 a.m. and 2:30 p.m., which reduced the teacher-student ratio during those times. For the purposes of this study, Mrs. Benedict was considered the lead teacher for science instruction, making the decisions and implementing the curriculum.

The physical classroom was originally designed for kindergarten students and was spacious enough to accommodate the varied activities occurring there. Figure V.1 provides a diagram of the classroom. Learning centers were designated and labeled, such as the math center, the writing center, the science center, and the housekeeping center.
Figure V.1 Diagram of Mrs. Benedict’s Classroom (not to scale). Unlabeled rectangles are shelving units.
Materials were well organized in labeled bins and appeared to be in good condition. The classroom also had an interactive SMART board the teachers used during their instruction. The classroom was an attractive, orderly, clean space; the general atmosphere was warm and welcoming.

Beliefs

This first section will focus upon Mrs. Benedict’s views on science teaching, her understanding of inquiry, her materials in the classroom, her beliefs about curriculum, and her opinions about the Young Scientist Series.

Beliefs About Science Teaching  I determined Mrs. Benedict’s beliefs about science teaching with the STEBI instrument and the pre study interview. Table V.1 shows each teacher’s score on the STEBI broken down by subscale. Mrs. Benedict is Teacher #2 on the table and is highlighted in bold. At the beginning of the study Mrs. Benedict scored a 33 on the Personal Science Teaching Efficacy Belief (PSTEB) scale, one of the two subscales of the STEBI. Compared to the other six teachers who completed the questionnaire, she scored the lowest on that subscale. Her score of 33 out of 65 fell at the bottom of a range of 33-52. On the Science Teaching Outcome Expectancy (STOE) scale, she scored a 46 out of a total of 60. The range of scores for the teachers on this subscale was 40-48, so Mrs. Benedict scored second from the top out of the seven teachers. Her total STEBI score was a 79 out of a possible 125. Her teaching peers’ scores ranged from 79 to 97, so she scored the lowest of all on the STEBI prestudy. Her scores on the STEBI at the beginning of the study reflected a teacher who was unsure of her ability to teach science effectively. An interesting sidenote is that all
Table V.1 STEBI Scores for Teachers.

<table>
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<tr>
<th>Teacher</th>
<th>PSTEB</th>
<th>STOE</th>
<th>Total</th>
<th>PSTEB</th>
<th>STOE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>1</td>
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<td>48</td>
<td>85</td>
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<td><strong>47</strong></td>
<td><strong>91</strong></td>
</tr>
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<td>90</td>
<td>--</td>
<td>--</td>
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<td>52</td>
<td>42</td>
<td>94</td>
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<td>7</td>
<td>44</td>
<td>40</td>
<td>84</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

--Teacher 2 and Teacher 4 were the two fully participating teachers.

--Poststudy data was not collected on Teachers 1, 3, 5, 6, and 7 because these teachers did not participate in the entire study.

Note: Mrs. Benedict’s scores are Teacher 2.

of the other teachers were given the opportunity to participate in this study. Although their scores on the STEBI were higher than Mrs. Benedict’s, five out of the six of them did not elect to participate.

When comparing Mrs. Benedict’s subscale scores to a group of 26 kindergarten teachers, her score of 33 on the PSTEB subscale was below the mean of the kindergarten teachers, which was 58.52 (Riggs & Enochs, 1990). Her total for the STOE subscale also
fell below that of the kindergarten teachers. Her score of 46 was lower than the kindergarten teachers’ mean of 48.58, though this difference was less than the PSTEB difference (Riggs & Enochs, 1990).

I analyzed Mrs. Benedict’s interviews using the same three steps I used to analyze Mrs. Kennedy’s. For a detailed description of how I analyzed the qualitative data, please see Chapter 4.

After chunking and coding Mrs. Benedict’s interview transcript for the constant comparative analysis, I consolidated the codes into an emergent theme statement. For detailed examples of how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix R. This theme statement was as follows:

Science was often taught at a science center connected to a classroom theme. The teacher might pull out games or experiments on such topics as colors, baking, volcanoes, and oceans for around 45 minutes per week.

Although she mentioned that “every now and then we would do a group experiment,” (L. Benedict, personal communication, September 2011) the subject of science was not taught explicitly to the whole group of students.

Mrs. Benedict’s poststudy scores of the STEBI increased on both subscales (shown in Table V.1). She scored a 44 on the Personal Science Teaching Efficacy Belief Scale, an increase of 11 from her prestudy score. On the Science Teaching Outcome Expectancy scale she scored a 47, slightly higher than her prestudy score of 46 on that subscale. Her total score of 91 was 12 points higher than her prestudy total score.
Table V.2  Mrs. Benedict’s Pre STEBI to Post STEBI Response Shifts.

<table>
<thead>
<tr>
<th>Shift of STEBI Items</th>
<th></th>
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<tbody>
<tr>
<td>Agree to disagree</td>
<td>0</td>
</tr>
<tr>
<td>Disagree to agree</td>
<td>2</td>
</tr>
<tr>
<td>Uncertain to agree</td>
<td>5</td>
</tr>
<tr>
<td>Uncertain to disagree</td>
<td>0</td>
</tr>
<tr>
<td>Disagree to uncertain</td>
<td>5</td>
</tr>
<tr>
<td>Remained the same</td>
<td>13</td>
</tr>
</tbody>
</table>

In terms of the response shifts on the STEBI, Mrs. Benedict’s shifts all moved in a positive direction. This was calculated after reverse scoring of negative items had occurred. She did not answer any questions with a strongly disagree or strongly agree response on the pretest or the posttest. Although she did have some responses that remained the same, the responses that changed all changed in a positive direction, either from disagree to uncertain, disagree to agree, or uncertain to agree. Her response shifts can be seen in Table V.2. Her pre and posttest results showed a teacher who gained confidence in her ability to teach science effectively.

Specific examples of Mrs. Benedict’s science teaching and how it evolved will be described in the section discussing the observations made during the study.

Beliefs About Inquiry  Mrs. Benedict’s beliefs about inquiry shifted during the course of this study. When she originally completed the Inquiry Teaching subscale, she scored a 56 out of a possible 76. For the six teachers who fully completed this subscale at the beginning of the study, the scores ranged from 50 to 69, so Mrs. Benedict’s score fell in the middle. Out of the four possible responses (strongly disagree, disagree, agree,
and strongly agree), she avoided extremes. In fact, she did not answer any of the questions with a strongly disagree or strongly agree response. Out of the 19 items on the subscale, she responded negatively to only one: I feel comfortable with the science content in my curriculum. All others were answered positively after rescaling negatively worded items. Her initial completion of this instrument reflected a teacher who was generally comfortable with the concept of science inquiry, but not to an extreme level.

When analyzing Mrs. Benedict’s view on inquiry in her prestudy interview, several themes emerged. These themes are consolidated in the following statement (for more detail, see Appendix S):

In inquiry the teacher guides the children to question, think, explore, and talk about topics like the seasons. If the teacher cannot answer a question, she helps the students look it up. Mrs. Benedict does a lot of that, but is excited about having the researcher tell her more about inquiry, which she thinks is a part of the curriculum.

After the constant comparative and domain analyses, I developed a taxonomic analysis in the same manner as described in Chapter 4. The taxonomic analysis for the inquiry teaching category used the attribution domain and is shown in Figure V.2. As reflected in the taxonomy, Mrs. Benedict’s responses were divided into three categories: what the children do, what the teacher does, and what she believes about inquiry.

Mrs. Benedict had ideas of what inquiry teaching entailed at the beginning of the study. She acknowledged skills the students use during inquiry, such as questioning, thinking, talking, and exploring. She viewed the teacher’s role as one of a guide, helping the students look up answers to their questions. Although she mentioned exploration in
Figure V.2  Taxonomic Analysis of Mrs. Benedict’s Views of Inquiry Science Prestudy.

In her interview, she did not discuss experiments in an explicit way. She specifically spoke of helping students answer their questions through technology:

I just think it’s more exploring and inquiring and questions and talking about how things work, and then maybe looking it up in a book or on the computer if, and then google it or whatever. That’s a lot of what we do as far as things that we can’t answer. Google it and see, and we can show pictures and that kind of thing

(L. Benedict, personal communication, September 2011).

Looking at Mrs. Benedict’s Inquiry Teaching subscale and her prestudy interview, she appeared to value science instruction and inquiry. She also possessed a basic understanding of some processes of inquiry. She acknowledged her own shortcomings in terms of science content knowledge, but used tools (such as books and the internet) to
help her address her perceived deficits. The excitement she shared in her interview about using the curriculum was also reflected in her answer to an item on the Inquiry Teaching subscale. She agreed with the following statement from the Inquiry Teaching subscale: I would be interested in working in an experimental science curriculum.

Mrs. Benedict’s poststudy scores reflected some changes in her ideas about inquiry science. Her posttest total on the Inquiry Teaching subscale was a 65 out of 76, reflecting a 9-point increase on her views of inquiry from the prestudy total. On the initial administration of this subscale, she did not mark any items as strongly disagree or strongly agree. This changed, however, on the posttest. All of her statements with a strongly agree answer (after adjusting for negatively scored items) were positive statements about inquiry, and she answered eight items in that manner. Although the STEBI scores showed a trend towards more positive responses at the end of the study, this trend for the Inquiry Teaching subscale was different because her posttest answers were more extreme. For one question, she shifted from disagree to strongly agree: I feel comfortable with the science content in my curriculum.

On one question, she shifted from disagree to agree, which was the following: I have a difficult time understanding science. This was the only item that moved from a positive to a negative view. I thought about this, and I have developed two hypotheses for why this question moved from a positive to a negative response. One possible explanation is that Mrs. Benedict still had insecurities about her inquiry teaching, and these insecurities were likely to emerge in some response. A second explanation is that when a person gains more knowledge, that person then can realize her or his deficits more clearly. Since Mrs. Benedict had a deeper understanding of inquiry when the study
Table V.3 Mrs. Benedict’s Pre Inquiry Teaching Subscale to Post Inquiry Teaching Subscale Response Shifts.

<table>
<thead>
<tr>
<th>Shift of Inquiry Teaching Subscale Items</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree to disagree</td>
<td>2</td>
</tr>
<tr>
<td>Agree to strongly agree</td>
<td>8</td>
</tr>
<tr>
<td>Staying the same</td>
<td>9</td>
</tr>
</tbody>
</table>

ended, she became more aware of her own lack of content knowledge. For all of the other questions she either stayed the same, shifted from agree to strongly agree, or shifted from disagree to strongly disagree. Table V.3 reflects this data. It appears that Mrs. Benedict, who had positive views about inquiry at the beginning of the study, became even more positive about it at the end as reflected on the Inquiry Teaching subscale.

For the poststudy interview, I analyzed the data in the same manner as the prestudy. After chunking and coding the interview transcript for the constant comparative analysis, I wrote an emergent theme statement that consolidated the interview information. For detailed examples of how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix T. This theme statement was as follows:

The flow chart of having the students wonder, question, observe, try things, and figure them out was inquiry. Sometimes Mrs. Benedict wanted to show them the book too soon because she was uncomfortable with questions, so she said she
should slow down. She would hone in on their interests and keep the circle of inquiry going.

Mrs. Benedict saw inquiry as more of a circular process at the end of the study. She still acknowledged the use of process skills with the students as well as the importance of considering their interests. She also admitted that, because of her own discomfort with questions she cannot initially answer, she was too quick to go to a book to find the answer. Although this was reflected in her prestudy interview, her self-reflection in realizing that she does this too readily was more apparent in the poststudy interview. “I think for me a lot of times I was trying to show them the book maybe
before they were asking questions, and maybe I needed to slow down a little bit” (L. Benedict, personal communication, December 2011).

The poststudy taxonomic analysis was similar to the prestudy one. The three general categories remained the same, although I labeled them slightly differently. For instance, children on the prestudy analysis became student processes on the poststudy one. Particularly on the teacher category, many of Mrs. Benedict’s responses were virtually the same. For that category, she discussed more of her personal experiences in the poststudy interview. Figure V.3 shows the taxonomy of her responses to the poststudy interview.

Mrs. Benedict had positive views of inquiry before and after the study. Her positive views became more extreme when the study was completed. Probably her deepest realization was that she needs to slow down and not be so quick to answer the children’s questions with a book or an electronic resource. She still acknowledged that she uses books and computers, but tried to help the children experiment first:

What would happen if we did this, what are you interested in knowing about.

Writing that down and talking about if we did this, what would happen. Just like when we did the crickets and trying different things, so just experimenting with it then trying it if they have a question about something, trying to figure out how we can answer that question, how they can answer it (L. Benedict, personal communication, December 2011).

Materials Checklist  As stated in Chapter 4, Tsunghui’s (2006) study on the preschool science environment found that half of all preschool classrooms had a science area available, most of them situated near a window. Mrs. Benedict’s classroom reflected
this finding. Her science area was located on a windowsill next to a table that was used as a science center during center time. She had many materials available to her at the beginning of the study.

Of the six teachers who completed the Materials Checklist at the beginning of the study, she scored her availability of materials highly. On the subscale of Science Materials, her score of 13 was at the top of the range of 7-13. Most notably, she had living things in the classroom, including fish, frogs, and plants. She also had an outdoor garden available just outside the classroom. On the Science Equipment subscale, her score of 14 fell near the median of a range of 10-17. She had items such as binoculars, funnels, measuring equipment, prisms, and rulers. On the Natural Materials subscale, her score of 7 fell near the median of a range of 3-9. She had bird’s nests, fake fossils, insects, seeds, pine cones, and seashells. Her total score also fell near the median: She scored a 34 in a range of 20-39.

Mrs. Benedict’s classroom had a large number of science resources as reflected by her score on the Materials Checklist. When appropriate materials are not available for use, it is difficult for a teacher to teach the subject effectively. Mrs. Benedict’s materials enabled her to include science as an area of study in her classroom.

**Beliefs About Curriculum** Mrs. Benedict’s beliefs about curriculum were determined from her pre and poststudy interviews. For detailed examples of how the chunks were coded, how the codes were grouped, and the theme statement that emerged, please see Appendix U. Using the codes derived from the constant comparative analysis, I created an emergent theme statement:
The only set curriculum Mrs. Benedict used prior to this study was the preschool literacy program. She draws upon past ideas, resources, and websites, and likes to try and play with new ideas. Although she thinks it’s great and exciting to implement a curriculum, she stated that it’s work because you have to pick and choose activities you want to do within time constraints. When choosing activities she considers the kids’ attention spans, opting for activities involving music, movement, games, talking, tools, and experiments. She uses what is in the curricular package, but doesn’t repeat activities if they don’t work.

Mrs. Benedict’s prestudy views on curriculum show a teacher who sees both the positives and negatives of utilizing a curricular package. While she shared her excitement about trying something new, she acknowledged the difficulty of figuring out what to teach within the time frame she had available.

The poststudy interview did not inquire about how Mrs. Benedict’s teaching had changed as a result of the study. This information was largely gleaned from the observations that occurred, which will be shared in detail in the next section. At the end of her interview, however, I asked if there was anything else she wanted to add. At that time, she spontaneously shared how her views of science teaching had changed:

It’s just nice to know that something’s out there, too. Because now it makes what we were doing before kind of seem pretty pathetic. But the other thing, too, is that with that science, there’s so much you can, like even finding that Eric Carle book when we had the crickets and just bringing in other things to go with it. It allows for that, it definitely allows for it, so it’s nice that it’s not like we were just doing science at the science center. We could do things, science around the room,
so they were writing and drawing. I mean it incorporated a lot of center, a lot of
different activities and areas where the kids could participate and not just be in
science (L. Benedict, personal communication, December 2011).

After using the Young Scientist Series curriculum, Mrs. Benedict’s views of
science teaching shifted. Her view that science was largely isolated to the science center
changed to one that integrated science into the other subject areas.

Beliefs About The Young Scientist Series  At the conclusion of the study I asked
Mrs. Benedict to share her feelings about the Young Scientist Series curriculum. I first
asked about what she perceived the strengths of the program to be. I consolidated the
codes from the constant comparative analysis to develop a theme statement on her views
(for more detail, see Appendix V):

The book was perfect and easy to follow, with helpful examples. The circle time
was short to accommodate attention spans, though students did well when it went
longer. She felt the students could have stayed outside longer. She would have
liked to do more and use more of it if she didn’t have time constraints.

When asked about the weaknesses of the curriculum, she was reluctant to mention
anything specific to the curriculum. She stated that the weakness was not in the
curriculum, but in the preschool. They had difficulty fitting it into their schedule with
their time constraints. Mrs. Benedict thought highly of this curricular package. It is
important to note, though, that she mentioned time constraints in her responses regarding
both strengths and weaknesses. This was a consistent theme in Mrs. Benedict’s response
to the pre and poststudy interview questions.
Observational Scale

For the purposes of this study, I formally observed Mrs. Benedict once a week for a total of eight observations. As with Mrs. Kennedy, I videotaped each observation, viewed each lesson two times, and completed the Preschool Science Lesson Observational Scale afterwards.

Table V.4 shows the information I collected regarding the curriculum implementation process for Mrs. Benedict. It is interesting not only to examine the trends of how closely Mrs. Benedict followed the curriculum from lesson to lesson, but also to look at the averages for each category on the instrument. The two most frequent observable actions were attempts and omissions. Their averages were roughly equal. Additions occurred, but not as frequently. Changes and new methods used were the least recorded. I will now go through each category of the Curriculum Implementation subscale of the Observational Scale and discuss the types of choices Mrs. Benedict made. I will not address the attempts she made: My focus will be on the ways she deviated from the curriculum.

Occasionally Mrs. Benedict made changes to the lesson. Sometimes this occurred when she altered the content of the whole group discussion at the beginning of the lesson and replaced it with another related topic. For instance, after a field trip to a botanical garden she reviewed the living things the children had seen there, helping them make connections between the field trip and their science instruction.

Changes also occurred in the order in which steps in the lesson occurred. In terms of safety issues, instead of discussing these with the whole group, she often talked about them in the small groups as the safety issues arose. This also occurred when discussing
Table V.4 Mrs. Benedict’s Observational Data

<table>
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<td>0</td>
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<td>10</td>
<td>1.25</td>
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</table>

respect for the living things. She reminded the children frequently to treat the animals kindly and gently, but it was usually during the exploration instead of during the whole group discussion.

The weather sometimes factored into the changes Mrs. Benedict made. Several of the observations occurred on snowy days when the children were not going to go outside. She tried to create an inside environment to help them understand the concepts. For instance, when it was snowy outside and the children were supposed to learn about the tools, she created an inside exploratory space. She put dirt into bins, along with seeds and small fake insects. The children were then encouraged to use the science tools to explore the materials in the bins.
Mrs. Benedict generally handled additions in two ways. First, sometimes she maintained an activity as prescribed in the curriculum, but added it sooner. For instance, on lesson one she discussed the science tools. While that was in the curriculum, it was supposed to be introduced in a later lesson. The same thing happened with the introduction of the mealworms for the Focused Exploration. I had brought the mealworms into the classroom and she had placed them in the windowsill. During the center time some of the children discovered the mealworms. Instead of making them wait to examine them, she got them out at the time the children showed interest in them. She also introduced supplemental books at the science center before that was actually mentioned in the curriculum. Although most of those books were non-fiction, when the students were learning about crickets, she read the fictional story, *The Very Quiet Cricket* to integrate science and language arts.

Occasionally Mrs. Benedict added other activities to the progression of the lesson. For instance, sometimes she led a whole class discussion, then had the children go out to recess. She had the entire class play, then selected a small group to do the science exploration. For another lesson, she inserted a music and movement time into the lesson. It was an inside snow day, so the children needed some gross motor movement at that time in order to stay focused on the instruction.

One interesting activity Mrs. Benedict added she termed *Science Around the Room*. The students had engaged in *Reading Around the Room* and *Writing Around the Room*. Mrs. Benedict took this one step further and introduced Science Around the Room as a time the students took clipboards and paper and went around the classroom on a quest to find living things.
Occasionally she also introduced content that was not yet specified in the curriculum. She talked often about living and non-living things. In at least three of the observed lessons she discussed the needs of living things with the students. Along with the needs of living things, she also spoke with the children about the life cycles of the different living organisms in the classroom during at least two observations.

One of the primary additions Mrs. Benedict incorporated into her whole group lessons was a review of previous material. She often went over what had been covered in the previous lesson even if that step was not explicitly stated in the prescribed lesson.

During the last two lessons Mrs. Benedict set up two science centers, one with the crickets and one with the mealworms. Students could spend time at one or both tables. Often students went from one table to the other, examining the different living creatures. The new methods section of the Preschool Science Lesson Observational Scale often overlapped with the additions section, and those new methods have already been discussed. When looking at the difference between additional and new methods, it was determined that additions were additions to the content of the lesson. For instance, if a lesson was about exploring science tools, and Mrs. Benedict discussed the needs of living things, that was considered strictly an addition because it was related to content. New methods were something completely new or different that was included in a lesson. One new method was the Science Around the Room activity mentioned earlier because it was a completely new activity that was not addressed in the curriculum at all. During the discussion of inter-rater reliability, it was decided that double coding could occur on this instrument. Therefore, all of the new methods were labeled as additions, but some of the additions were not considered new methods.
Omissions were many, and they generally followed a pattern. Although Mrs. Benedict began each lesson with a large group discussion, sometimes the topics of the discussion varied from what the curriculum recommended.

Omissions of documentation also occurred regularly throughout the course of the study. Mrs. Benedict did not use any of the documentation forms during the small group time with the students. This was consistent through all of the observations. She also did not complete charts and documentation panels the curriculum recommended, especially at the end of her lessons.

Although Mrs. Benedict encouraged the students to record their observations, she did not capitalize on the chance to help them refine their drawings by probing them further. The curriculum also involves regular outside exploration. This happened during the first two lessons, but did not happen after that point. While weather was a contributing factor, there were times when the students could have been encouraged to go outside and make comparisons between their observations during different types of weather.

Probably the most glaring omissions occurred at the end of the lessons. The small group discussion and large group discussion did not occur. Because of this, most of the activities described at the end of the lessons were absent. Summaries of the content did not happen at the end of the lessons. Instead, several times Mrs. Benedict used the whole group time at the beginning of the lesson to review information previously covered.

Mrs. Benedict did not seize opportunities to help the students compare themselves with animals. These chances to explore some higher level thinking did not explicitly
occur. For instance, one activity during the Observing Animals Up Close allows the children to move like the animals, but this did not happen. This omission was interesting given the fact that Mrs. Benedict’s interview showed she valued movement activities.

Mrs. Benedict omitted important components of the *Young Scientist Series* curriculum, such as specific discussion topics, documentation of learning, end-of-lesson discussions, and making comparisons. While she maintained the basic philosophy of the curriculum, she omitted as many activities as she included.

**Decisions Made**  During the course of this study Mrs. Benedict had many decisions to make. She had to decide when to implement the instruction, when to incorporate whole group versus small group discussion, when to move from Open to Focused exploration, which topic to cover in Focused Exploration, and what to cover during Focused Exploration.

**Scheduling.** Scheduling was one of the most difficult aspects of curriculum implementation for Mrs. Benedict. At the beginning of the study, she wondered how she was going to fit the science instruction into her busy schedule. In the prestudy interview, she stated the following:

We don’t always have a whole lot of time. That’s the one thing, time. It’s sometimes hard to get everything in in the amount of time that we have.

Everything we want to do. Way too much that we want to do (L. Benedict, personal communication, September 2011).

The issue of time was echoed at the end of the student in her poststudy interview. When asked about the weaknesses of the curriculum, she stated the following:
Weaknesses. I, gosh, the only and it’s really not a weakness, it’s just that there’s so much to do. And with us our weakness is that we don’t have, we have a large number of children and different schedules and different other things that we do as well, so it was, our weakness is trying to get it all in. I can’t think of anything that was difficult or, everything was helpful in the curriculum. It was basically us, I think, trying to implement it and not having as much time as we would have liked to have (L. Benedict, personal communication, December 2011).

The way Mrs. Benedict handled scheduling was conducting large group science talks right before center time. Then the students could engage in the science exploration during their center time. In this way, she was able to squeeze science instruction into an already full schedule.

**Whole Group Versus Small Group.** Mrs. Benedict had a large number of students in her class, so balancing whole group and small group activities was a consideration in her curriculum implementation. For the eight lessons observed, Mrs. Benedict conducted a whole group discussion at the beginning of all of them. Some were brief and some were more lengthy. Outdoor explorations in small groups happened for two observations until the weather got colder and more snowy. The rest of the small group time happened during the centers for six of the eight lessons. Though each lesson in the curriculum had a large group discussion as its conclusion, I did not observe Mrs. Benedict conduct any large group discussions at the end of the lessons.

**Student Choice.** Another choice Mrs. Benedict made related to her students’ choices. Except for the large group discussions occurring at the beginning of each lesson, students were allowed to choose to spend time at the science center or not.
Benedict was aware of the time requirements of the study, so she told me she would encourage all of the participants who took the SLA prestudy to spend time at the center. Still, the times each student spent of the science center varied. Some stayed for the full center time, some stayed for part of the time, and some did not spent much time there at all. These variations in time spent at the center may have affected the results of the study.

**How Soon to Move From Open Exploration to Focused Exploration.** We established a timeline at the beginning of the study that the teachers would spend four weeks on Open Exploration and four weeks on Focused Exploration. Mrs. Benedict spent time on the different steps of the curriculum and did not rush into new steps. She spent two weeks on Step 1 of the Open Exploration, one week on Step 2, one week on Step 3, and one week on Step 4. Because of her decision to spend more time on Step 1, she moved into Focused Exploration during week six of the study instead of week five. Mrs. Benedict seemed very comfortable allotting more time to concepts if she thought it was something the students needed.

**Focused Exploration: Plants or Animals.** At the conclusion of Open Exploration, Mrs. Benedict had to decide whether or not to focus more closely on plants or animals. During week four of the study, I gave the students an informal interest assessment to determine their preferences. Mrs. Benedict waited until I had completed the assessments to decide which subject to study. She wanted to make sure she considered her students’ feelings and interests before making a decision.

I administered the Preschool Student Interest Assessment to 28 of the students. Of the 28 students, 18 preferred animals (64%), 9 preferred plants (32%), and 1 (4%)
liked them equally. A clear preference for animals existed in this class. When Mrs. Benedict learned the results of this assessment, she decided to pursue the topic of animals in Focused Exploration. She stated it in the following way:

I think we could have easily done either one. The fact that the kids were so interested in animals. I mean they were totally interested in the plants. I almost felt like, and I know you did the assessment, kind of a little assessment with them, too just to see where they were, so I wanted to go with their interest as well (L. Benedict, personal communication, December 2011).

**What to Cover During Focused Exploration.** During Focused Exploration, teachers begin by searching for animals, making a home for visiting animals, observing the animals up close, and then moving on to a more content-based focus. At that point, some of the choices offered in the curriculum were focusing on animals’ body parts, behavior, and/or life cycles.

I did not observe Mrs. Benedict searching for animals or making a home for visiting animals, largely because I had provided animals and their habitat needs to her already. During the Focused Exploration I provided the class with mealworms, crickets, ants, and their corresponding habitats. I believe it was because this was already done that Mrs. Benedict did not include those steps in the Focused Exploration process. She seemed to move directly to observing the animals up close and continued in that step for the duration of the study.

Although Mrs. Benedict discussed the animals’ body parts, behavior, and life cycles during the center times, those topics were not included in an explicit way. They were more an extension of examining the animals. Because of this, I felt that she spent
the last three weeks of the study having the children observe the mealworms, crickets, and ants up close in a manner more closely resembling Open Exploration. She recognized this when asked about the levels of inquiry in the curriculum, stating the following:

You can take it where wherever they are. So you know I would say that we did it. I think we were a little more loose with it and kind of let the kids go, they took it where they wanted to go or where they were ready to go with it. As far as, is very easy to do with preschool. But you could go, I think do even more structure with it and more, it gives you that option. Does that make sense? I don’t know if, I think you could do it either way. We did more loose. Not quite as detail-oriented with the actual the inquiry process and all that (L. Benedict, personal communication, December 2011).

**Student Questions** During each observed lesson, I transcribed the students’ questions and categorized them according to whether or not they asked procedural questions or curiosity questions. I found that a second viewing of the videotapes usually revealed more student questions than I had heard during the first viewing, so I watched each videotaped lesson two times.

I had one difficulty in transcribing the students’ questions. Many of the lessons involved videotaping the children at the science center while the other students worked at other centers in the room. Since this class had up to 24 students, often the sound level in the room was very high and made it difficult to hear everything that happened at the science table distinctly. I noted on the Observational Scale that for lessons 4, 6, and 7, it was difficult to hear everything that was said clearly. This may have caused my data to
Table V.5 Student Questions During Mrs. Benedict’s Lessons

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Total</th>
<th>Mean</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Procedural</td>
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<td>17</td>
<td>9</td>
<td>10</td>
<td>16</td>
<td>10</td>
<td>3</td>
<td>8</td>
<td>80</td>
<td>10</td>
<td>53</td>
</tr>
<tr>
<td>Curiosity</td>
<td>14</td>
<td>13</td>
<td>3</td>
<td>1</td>
<td>18</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>59</td>
<td>7.38</td>
<td>39</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>11</td>
<td>1.38</td>
<td>7</td>
</tr>
</tbody>
</table>

*The noise level made it difficult to hear the questions during these lessons

be less accurate. Because of this, I added a category on the Observation Scale of

unknown. If I could tell a question was being asked, but I could not hear it clearly, I
marked it as unknown. A few other questions I marked as unknown because it was
difficult to categorize them into procedural or curiosity. For examples of how questions
were categorized, please see Chapter 4. Table V.5 shows the breakdown of student
questions during the eight lessons I observed. A majority of the questions asked were
procedural (53%), some were curiosity (39%), and a small number were unknown (7%).

Overall Levels of Inquiry For a review on how the Observation Scale was
created, please see Chapter 4. Table V.6 shows the breakdown of levels of inquiry for
Mrs. Benedict. On the numbered scale, two of the lessons scored a 0, three scored a 1,
two scored between a 1 and a 2, and one scored a 2. In terms of the overall level of
inquiry in her lessons, all eight lessons were labeled guided inquiry. Mrs. Benedict
balanced her lessons in terms of the levels of inquiry. For some lessons she provided the
Table V.6  Levels of Inquiry in Mrs. Benedict’s Lessons

<table>
<thead>
<tr>
<th>Inquiry</th>
<th>Lesson Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Numbered Scale</td>
<td>0</td>
</tr>
<tr>
<td>Overall Level</td>
<td>G</td>
</tr>
</tbody>
</table>

*Note: O= open inquiry, G=guided inquiry, S=structured inquiry

problems/questions, procedures/methods, and solutions, and for some she and the students figured these out together. I did not observe any lesson where the students constructed the problem/question, the procedure/method, and the solution themselves. This goes along with the overall level of inquiry of the lessons, because the guided inquiry designation states that there is a balance between teacher-led and student-led activities.

**Connection Between Levels of Inquiry and Prestudy Attitudes on STEBI, Inquiry Teaching Subscale, and Materials Checklist**  Mrs. Benedict started the study with the lowest score of her peers on the STEBI. Her score on the Inquiry Teaching subscale was close to the median score. The materials she had available in her classroom were also in the median range when compared to the other teachers who completed the survey.

Mrs. Benedict seemed tentative when beginning the study. When I walked in, she often would tell me about her plans in a questioning manner. This was supported by her
lower score on the STEBI. I often felt that she wanted approval for what she had
planned. My response to her was, “Do what you think is best. Part of this study involves
looking at the choices you make and why you make them.” As the study continued she
seemed to gain confidence in what she was doing. She did not talk with me as much
about her plans: She just implemented them. Near the end of the study I watched as she
and the students devised an experiment to see if the crickets in the classroom would
chirp. While she started off by turning off the lights and gave the students suggestions
for what they could do, the students quickly got involved and made some of their own
choices. They decided that turning off the lights was not enough, so they decided to hide
so that the crickets would not see them moving. Watching this simple experiment
exemplified inquiry teaching for me at this preschool level.

Mrs. Benedict’s score on the Inquiry Teaching subscale fell in the middle of the
group of teachers. Before the study began her interview showed a better understanding
of inquiry science than that of most of the other teachers interviewed. When
implementing the curriculum, she moved back and forth from teacher-led to a
combination of teacher- and student-led activities. Her choices considered the students’
interests and needs, and she met them where they were.

Student Data The student data consisted of pre and posttest scores on the SLA
and posttest scores on the PISCES. I also asked Mrs. Benedict to describe her students’
responses to the curriculum in the poststudy interview.

Pre and Post SLA. As explained previously, because of the timing of
consent/assent form returns, I collected data for different numbers of students for the
various assessments. I administered the SLA posttest to more students because more
Table V.7 Descriptive Statistics Wright Preschool SLA Pretest and Posttest

<table>
<thead>
<tr>
<th></th>
<th>SLA Pretest Total</th>
<th>SLA Posttest Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Valid</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>4.82</td>
<td>5.82</td>
</tr>
<tr>
<td>Median</td>
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<td>6.00</td>
</tr>
<tr>
<td>Mode</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1.551</td>
<td>1.425</td>
</tr>
</tbody>
</table>

Figure V.4 SLA Pretest Total Distribution (with the curve of the normal distribution shown).
Figure V.5 The SLA Posttest Total Distribution (with the curve of the normal distribution shown).

students had joined the study after the curriculum implementation began. For clarity, in this section I will only include data from the students for which I have both pre and posttest data on the SLA. Table V.7 shows the basic descriptive statistics for the pre and posttests. Figure V.4 and Figure V.5 show the total distribution of scores on the SLA pretest and SLA posttest. I used SPSS to run statistics on the student assessments. In order to determine if there was a statistically significant increase between the SLA Pretest
and SLA Posttest, I ran a paired samples t test. The p value of .004 shows statistical significance, reflecting that the difference was not likely due to chance.

The students at Wright Preschool performed better on the SLA posttest than the SLA pretest, and their increased performance was statistically significant. One possible explanation was that the way Mrs. Benedict used the *Young Scientist Series* curriculum helped her students develop their science process skills.

**PISCES.** The PISCES assessment was given to the students at the end of the study to determine their attitudes towards science. This assessment was not given as a pretest for reasons stated in Chapter 4, so I could not compare pre and posttest scores for the same group of children. I did look at trends in the distributions and compared the students’ scores from the two schools. Figure V.6 shows the distribution of scores of the students from Wright Preschool, and Table V.8 shows the descriptive statistics. The distribution was negatively skewed, as the mean was lower than the median and the mode was higher than the median (Bluman, 2003). This indicated that a majority of students scored highly on the assessment. I also completed the PISCES analysis on the full study population and found that that information corroborated the information from the complete study population.

Along with the PISCES quantitative scale, I also asked Mrs. Benedict about how her students responded to the science lessons. By addressing this in the qualitative interview, I could triangulate my findings regarding the students’ attitudes towards science. Mrs. Benedict indicated that her students responded positively to the lessons. After chunking and coding the data from the interview, the emergent theme statement on this topic was as follows (for more detail, see Appendix W):
The students were eager and went bonkers. It was great for them, as they engaged in questioning, sharing, and drawing. They shared and found plants and animals. Some were on and some were confused, but they felt good about sharing. They were into it outside and stayed at the indoor center a long time, which was unusual. They had a great response to the curriculum, including their reactions during large circle time.

Figure V.6 The PISCES Total Distribution (with the curve of the normal distribution shown).
Table V.8 Descriptive Statistics Wright Preschool PISCES

<table>
<thead>
<tr>
<th>Statistics</th>
<th>PISCES Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>16</td>
</tr>
<tr>
<td>Valid</td>
<td>16</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>10.31</td>
</tr>
<tr>
<td>Median</td>
<td>11.00</td>
</tr>
<tr>
<td>Mode</td>
<td>12</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>2.152</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.290</td>
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<tr>
<td>Std. Error of</td>
<td>.564</td>
</tr>
<tr>
<td>Skewness</td>
<td></td>
</tr>
</tbody>
</table>

Although I did not score the students on engagement during the lessons I observed, I noticed that Mrs. Benedict’s students had a very strong engagement while participating in the science activities. They spent large amounts of time observing and often excitedly shared their thoughts and observations with the teacher and with other students.

Both sources of information about the students’ attitudes, the PISCES and the teacher interview, indicated that the students at Wright Preschool felt positively about science.

Conclusion

At the beginning of this study Mrs. Benedict was a preschool teacher with some self-doubt about her ability to teach science effectively. While she had positive views about inquiry, she felt insecure about using it in the classroom. She was open to using the *Young Scientist Series* curriculum even though she knew she would have to do some
problem solving to fit it into her already full schedule. She acknowledged that using a new curriculum required hard work, but also saw the opportunities available in trying something new.

When Mrs. Benedict taught the curriculum she made many decisions about how to use it. She included about the same number of activities from the lessons as she excluded, and she incorporated changes and additions in smaller numbers. Her omissions were largely related to debriefing discussions at the end of lessons, documentation of student learning (both teacher and student), and making comparisons. Most of the activities were included in the center time already established, with some brief whole-group discussions prior to center time beginning. She spent five weeks on the Open Exploration phase, moving on to study animals for the Focused Exploration. When she taught the Focused Exploration, she included several kinds of small animals. In terms of content, however, she did not delve into specific content knowledge in an intentional way.

Mrs. Benedict incorporated inquiry into her lessons. The levels of inquiry ranged from teacher-directed to teacher- and student-directed, but were never completely determined by the students. This may have been due to the young age of her students. In terms of the overall level of inquiry of her lessons, they were all guided inquiry, offering a balance between teacher- and student-led activities.

The student data from Mrs. Benedict’s students reflected a statistically significant increase on their science process skills. They also had positive views of science. It appears that Mrs. Benedict’s decisions and teaching style may have affected her students in positive ways, both in learning and in positive attitudes. Mrs. Benedict’s manner of
quietly talking with her students about their questions, modeling wondering for them, and providing them with open-ended materials worked. Although she omitted components of the lessons, her choices were philosophically aligned with it, reflecting one of the goals stated in the teachers’ guide: “Develop scientific dispositions including curiosity, eagerness to find out, an open mind, respect for life, and delight in being a young naturalist” (Chalufour & Worth, 2003, p. 4). She made the curriculum work in her classroom situation. Her use of the curriculum not only helped her students, it helped her become more confident as an inquiry-based science preschool teacher. This curriculum implementation was a positive experience for Mrs. Benedict and her preschool students.
CHAPTER

VI. COMPARISONS AND CONCLUSIONS

Structure of the Chapter

In this final chapter, I will provide a comparison between Mrs. Kennedy and Mrs. Benedict. I will discuss their similarities and differences on science teaching efficacy, beliefs about inquiry teaching, materials available, observations, decisions, student questions, levels of inquiry employed, and student data. Teacher data was consolidated in Table VI.1, and student data was consolidated in Table VI.2.

After that, I will revisit the research questions presented in Chapter 1 and determine whether or not those questions were answered by the study. Part of this discussion will include the hypotheses shared in Chapter 1 and whether or not they were supported by the data or not. Following this section, I will discuss the limitations of the study. I will then offer some ideas for future research in early childhood science education. After that, I will offer suggestions for helping early childhood teachers teach science more effectively. I will conclude the chapter with a brief synthesis of the information gathered.

Efficacy and Science Teaching At the beginning of the study, Mrs. Kennedy and Mrs. Benedict had different totals on the STEBI. Mrs. Kennedy scored second from the highest of the seven teachers who completed this questionnaire prestudy, and Mrs. Benedict scored the lowest. Mrs. Kennedy seemed confident in her ability to teach science effectively, while Mrs. Benedict felt more unsure of herself.
Table VI.1 Comparison of Teacher Data.

<table>
<thead>
<tr>
<th></th>
<th>Kennedy</th>
<th>Benedict</th>
</tr>
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<tbody>
<tr>
<td>STEBI Pretest</td>
<td>94</td>
<td>79</td>
</tr>
<tr>
<td>STEBI Posttest</td>
<td>94</td>
<td>91</td>
</tr>
<tr>
<td>Difference Pre to Post</td>
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<td>+12</td>
</tr>
<tr>
<td>Inquiry Pretest</td>
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<td>56</td>
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<tr>
<td>Inquiry Posttest</td>
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<td>65</td>
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<tr>
<td>Difference Pre to Post</td>
<td>-7</td>
<td>+9</td>
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<tr>
<td>Materials Checklist</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attempts-total/mean</td>
<td>71/8.875</td>
<td>62/7.75</td>
</tr>
<tr>
<td>Changes-total/mean</td>
<td>17/2.125</td>
<td>15/1.875</td>
</tr>
<tr>
<td>Omissions-total/mean</td>
<td>42/5.25</td>
<td>58/7.25</td>
</tr>
<tr>
<td>Additions-total/mean</td>
<td>24/3</td>
<td>18/2.25</td>
</tr>
<tr>
<td>New Methods-total/mean</td>
<td>10/1.25</td>
<td>10/1.25</td>
</tr>
<tr>
<td>Numbered Levels of Inquiry</td>
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<td></td>
</tr>
<tr>
<td>Zero (0)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>One (1)</td>
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<td>3</td>
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<td>Two (2)</td>
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<tr>
<td>Three (3)</td>
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<td>0 of 8</td>
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<td>Guided</td>
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<td>8 of 8</td>
</tr>
<tr>
<td>Structured</td>
<td>5.5 of 8</td>
<td>0 of 8</td>
</tr>
</tbody>
</table>
When I asked the teachers to describe how they had taught science previously, they answered in similar ways. Both of them shared how they had handled science topics during center times as part of their thematic units. Neither of them had taught science in a deliberate, intentional way previously. Mrs. Kennedy expressed that she had wanted to include more science in her schedule. Both teachers were positive about the study at the beginning, though tentative about how it would evolve.

When the study was complete, Mrs. Kennedy scored the same total on the STEBI that she had at the beginning of the study. Mrs. Benedict, however, gained 12 points on her poststudy score on the STEBI. While three of Mrs. Kennedy’s responses moved in a more negative direction, all of Mrs. Benedict’s shifted in a positive direction. The items on which Mrs. Kennedy scored more negatively were all related to believing that good teaching can overcome student limitations. In some ways Mrs. Kennedy felt less confident when the study ended. Mrs. Benedict’s scores showed that she gained confidence as the study continued. This was reflected not only in her scores on the STEBI, but in her basic demeanor during the study. At the beginning, she often asked me about the activities she had planned or told me about them with a questioning tone. As the study progressed, she did this less and less and started trusting her own decisions more.

When considering beliefs about science teaching, the data reflected that Mrs. Benedict benefitted most from the curriculum implementation. She worked the curriculum into her existing schedule, often using center time to engage the students in science. Her comfort level with open-ended activities showed. Mrs. Kennedy taught the curriculum, but she handled her lessons in a more structured manner. Near the end of the
study, a couple of her students wanted to play instead of participating in the science activities. While this was normal for preschoolers, I think that Mrs. Kennedy internalized it and felt discouraged by it. She executed her lessons with conscientiousness, going to great lengths to plan meaningful activities. It is my hope that she can feel empowered again as she continues to work on her science instruction.

**Inquiry Subscale: Pre and Post** At the beginning of the study, Mrs. Kennedy scored highly on the Inquiry Teaching subscale, with a total of 67 out of 76. Her score fell second from the top of the six teachers who completed the instrument. After rescoring negatively worded items, she answered every item with an *agree* or *strongly agree* response. Mrs. Benedict, however, scored lower on this subscale with a total of 56 out of 76, placing her in the middle of the group of teachers who completed the survey. She never responded with a *strongly agree* or *strongly disagree* answer on the pretest. She answered only one question in a negative way, the question about feeling comfortable with the science content in her curriculum. Both Mrs. Kennedy and Mrs. Benedict were positive about inquiry teaching at the beginning of the study.

At the end of the study, Mrs. Kennedy’s total on the Inquiry Teaching subscale declined from 67 to 60. While she answered all of the items in a positive way, they were not as strongly positive as at the beginning. Mrs. Benedict’s scores on the Inquiry Teaching subscale increased by 9 points, from 56 to 65. At the beginning, she did not answer any items with a *strongly agree* or *strongly disagree*, but by the end of the study she answered more items as *strongly agree*. As on the prestudy survey, she responded to only one item with a negative response. That item was the following: I have a difficult time understanding science. All of her other responses were positive.
Mrs. Kennedy had a basic understanding of inquiry science at the beginning of the study, as evidenced by her responses to the interview questions. She stated that inquiry science was when the kids asked questions, were enthused, and wanted to figure out what was next. When the study concluded, she maintained a similar definition of inquiry science. At the end, she included the process of answering questions with experiments to her definition, which was new. The taxonomies of her pre and poststudy responses reflected a basic understanding of inquiry science, and they were very similar.

Mrs. Benedict also possessed an understanding of inquiry science when the study began. She stated that the students question, think, explore, talk, and look up information. She also acknowledged student excitement as being a component of inquiry science. The taxonomy of her response showed three categories: teachers, students, and affect. Her poststudy taxonomy was very similar to her prestudy one. Those same three categories (though perhaps labeled with slightly different terms) existed on the poststudy taxonomy, too. Mrs. Benedict’s understanding of inquiry showed that she valued students’ process skills and felt they were important in inquiry science.

It is important to note that, although Mrs. Kennedy’s score decreased on the Inquiry Teaching subscale poststudy, she still answered all items with positive responses. Two possible explanations might explain the difference in her scores. She might have, through experience with the curriculum, realized the challenges of teaching with an inquiry focus. The qualitative data also indicated that Mrs. Kennedy felt most comfortable with structured lesson plans. Since inquiry can lend itself to more open-ended exploration, Mrs. Kennedy might have been less comfortable with this aspect of inquiry.
Mrs. Benedict’s final score on the Inquiry Teaching subscale was higher than Mrs. Kennedy’s even though she answered one item in a negative way. While she started the study with a positive view of inquiry, she ended with an even more pronounced positive feeling about it. She realized that, although she wants to find answers in books or on the internet, she needs to slow down and help the students figure out ways to answer their questions. Her teaching style was compatible with an inquiry focus.

**Materials Checklist** At the beginning of the study, both teachers completed the Preschool Classroom Science Materials/Equipment Checklist. On the Science Materials subscale, both teachers scored an identical total of 13. One of the most notable similarities between them was the outdoor garden that was available to both of them on the school grounds. At Burris Preschool, the spacious garden was available to all of the students at the school. Wright Preschool’s teachers planted their garden just outside their doors.

On the Science Equipment subscale Mrs. Kennedy scored a 17, the highest of the six teachers who completed the instrument. Mrs. Benedict scored a 14, near the middle. For Natural Materials, Mrs. Kennedy totaled 9, the top of the range of teachers, while Mrs. Benedict totaled a 7 near the middle of the range. Their totals showed that Mrs. Kennedy scored the highest of all of the teachers with a 39 and Mrs. Benedict fell in the middle with a score of 34.

Both teachers had science materials available to them at the beginning of the study, most notably an outdoor area to explore. On the topic of materials, Mrs. Kennedy often collected materials from her own yard, garden, or home. For instance, she brought in seeds and pumpkins from her personal garden and wasps from her home. Although
she scored highly on this instrument, I believe that part of what made her score so high was her awareness of all of the materials she had available to her and her willingness to plan ahead and bring them to her classroom.

Both teachers were given identical resources as the study began. For the Open Exploration phase of the curriculum, I gave them both all of the items listed in Table III.4 in Chapter 3. One difference occurred during the Focused Exploration phase. Mrs. Kennedy had moved to the Focused Exploration phase of the study two weeks ahead of Mrs. Benedict, so I provided her with an additional example of small animals (water snails) and their habitat. I feel that the variations in materials evidenced in the Materials Checklist and the one difference in resources provided to the teachers was not a variable in this study. Both teachers had ample materials to teach science effectively.

Beliefs About Curriculum  Both Mrs. Kennedy and Mrs. Benedict had distinct views on how they implemented a curricular program at the beginning of the study. Their responses showed more differences than similarities. This is not surprising given the more open-ended nature of the interview process.

Mrs. Kennedy stated that she had not used a packaged curriculum before at Burris Preschool. When starting to use a curricular program, she said she needed time to familiarize herself with the curriculum and see how it was going to flow. She liked to connect the curriculum to whatever theme they were studying in the classroom. She responded that at first she follows a curriculum closely, but adjusts it as time goes by when she develops a comfort level with it.

Mrs. Benedict remarked that she had used a literacy curriculum with her students. She often looked at past lesson plans, resources, and websites to figure out what to teach.
While she felt that it was exciting to use a new curriculum, she also acknowledged that it takes work to gain familiarity with the program at first. When she started to use a curriculum, she first used what was in the package. When she taught it after that, she eliminated the activities that did not work for her students.

Mrs. Kennedy and Mrs. Benedict had one very important similarity in how they implemented a curriculum. Both of them considered student needs when utilizing a program. Mrs. Kennedy commented that she considered the age of her students, which was appropriate since she taught two different age groups. Mrs. Benedict stated that she thought about her students’ attention spans and planned a variety of activities to accommodate their needs. Both teachers focused on the students when asked about how they utilized a curriculum.

**Young Scientist Series** Both Mrs. Kennedy and Mrs. Benedict identified strengths in the *Young Scientist Series* when the study ended. Mrs. Kennedy felt that the greatest strength of the curriculum was the hands-on nature of it. She liked how the students were able to immerse themselves in their study of the different animals. Mrs. Benedict cited different strengths of the program. Most notably, she responded that the *Young Scientist Series* curriculum made what she had done in science before look “pretty pathetic” (L. Benedict, personal communication, December 2011). Before the study, science had been more isolated to the science center. Through the course of the study, she was able to see how she could integrate science into other subject areas.

Both teachers were reluctant to share their perceived weaknesses in the curriculum. Although I think they were being honest in their interviews, they were both thankful to have been given the curriculum and all of the materials to teach it. This might
have caused them to downplay their perceived weaknesses of the program. Mrs. Kennedy stated that she would have moved from the Open Exploration phase to the Focused Exploration phase sooner than the curriculum dictated. The inference drawn from this statement was that she felt the Open Exploration phase was too long. Mrs. Benedict, however, said that the weakness was not in the curriculum, but in how she implemented it. She said it was difficult to fit all of the components of it into her already full schedule. Both teachers made many more positive statements about the Young Scientist Series than negative ones.

Observations For the observational data, Mrs. Kennedy and Mrs. Benedict had similarities and differences in how they implemented the curriculum. Looking at the raw data, Mrs. Kennedy made more attempts to follow the curriculum (see Table VI.1). Her attempts outnumbered her omissions. Mrs. Benedict, however, made approximately the same number of attempts to follow the curriculum as she did omissions to the program.

Both teachers omitted material in similar manners. Both of them left out having the students draw during some, but not all, of the lessons. Students’ drawings can offer valuable information about their understanding, so omitting that component deprived the teachers of assessment opportunities. Mrs. Kennedy and Mrs. Benedict often overlooked the end-of-lesson discussions suggested in the lesson plans, which also could have helped them evaluate their students’ knowledge. Neither teacher capitalized on the opportunity to help the children compare and contrast the different small animals to each other and to themselves. Both teachers did not take the children outside when the weather got colder. All lessons past the first few occurred inside. The only omission that occurred with Mrs. Benedict that did not occur with Mrs. Kennedy was the documentation of student
responses. While Mrs. Kennedy used her own format to record student questions and comments, Mrs. Benedict did not include this component of the curriculum. Mrs. Benedict omitted more material from the lessons, but her omissions were similar to Mrs. Kennedy’s in content.

Both of the teachers made additions to the lessons. Mrs. Kennedy and Mrs. Benedict introduced material meant for later lessons at earlier times in the curriculum implementation. Mrs. Kennedy’s additions were often related to bringing in more hands-on materials for the students, such as a wasp’s nest and puzzles. She also included a reading time at the end of several of her lessons. Mrs. Benedict changed the lessons by inserting different activities (music and movement, recess) into the middle of the science lessons to help the students exercise their gross motor skills. Probably her most innovative addition was the Science Around the Room activity. While Mrs. Kennedy’s additions were related to materials, Mrs. Benedict’s were related to activities.

Mrs. Kennedy made slightly more changes to the curriculum than Mrs. Benedict, but their numbers on this item were similar. Both teachers changed the order of activities of the lessons. Mrs. Kennedy also changed her documentation, her use of tools and resources, and the materials she used to teach. While it appeared that Mrs. Kennedy made more changes to the curriculum than Mrs. Benedict, some of her changes were alterations of components Mrs. Benedict omitted entirely.

Both teachers worked hard to plan and implement this curriculum. In terms of fidelity of implementation, Mrs. Kennedy included more components listed in the curriculum. She made more attempts and fewer omissions than Mrs. Benedict. She also made slightly more changes and additions to the curriculum.
**Student Questions.** The types of questions the students in these two classrooms asked were very similar. The students in Mrs. Kennedy’s class asked 58% procedural questions, while the students in Mrs. Benedict’s class asked 53% procedural questions. In Mrs. Kennedy’s class the students asked 35% curiosity questions, while in Mrs. Benedict’s class the students asked 39% curiosity questions. The unknown category was 7% for Mrs. Kennedy’s students and 7% for Mrs. Benedict’s students.

Since these teachers implemented the curriculum in different ways, the data regarding student responses were surprising. The data for their questions were very similar even though the lessons were handled in different ways. Most of the questions the students asked were procedural. Perhaps this should not be surprising given the young age of the students. After all, they need to clarify directions in order to understand what they need to do. It was interesting to note that in three of Mrs. Kennedy’s lessons, the curiosity questions outnumbered the procedural ones. I looked to see if there was a connection between levels of inquiry and the number of curiosity questions. For two of the three lessons in which this occurred, the lessons were guided inquiry, and for one it was structured inquiry. Mrs. Kennedy’s guided inquiry lessons were in the minority, so there may have been a connection between a more open level of inquiry and the types of questions students asked in her classroom. In two of Mrs. Benedict’s lessons, the curiosity questions outnumbered the procedural ones. In her case, it was more difficult to see a connection because all of her lessons were rated guided inquiry lessons. This subject would be interesting to pursue in more depth.

**Inquiry.** The levels of inquiry used in these two classrooms were different. For Mrs. Kennedy, a majority (5 out of 8) lessons incorporated structured inquiry, while 3
utilized guided inquiry. On the numbered rubric, all of her 0 scores happened during the structured inquiry lessons. There was not much range to her numbered scores: They were either a 0 or a 1. Her teaching style of feeling more comfortable with structure was supported by the observations of the levels of inquiry utilized in her classroom.

Mrs. Benedict used guided inquiry in all of her lessons. Her numbered scores ranged from a 0 to a 2, depending upon the lesson. She was more comfortable with open inquiry and described herself as loosely following the lessons.

**Decisions** Mrs. Kennedy and Mrs. Benedict made different types of decisions in their classrooms. In looking at their decisions, however, it is important to note that they had some important differences in their classrooms. Mrs. Kennedy had much smaller class sizes and teacher-student ratios than Mrs. Benedict. Therefore, one must consider this profound difference when considering how their decisions were made.

In terms of scheduling, Mrs. Kennedy allotted a set time when she would teach science each day. She planned a 45-minute session each day, and she adhered to that. Mrs. Kennedy, however, was more loose in her scheduling. She often squeezed in her whole group discussion, but used the center time already allotted to cover the science topics in the curriculum. While both teachers utilized the science curriculum, Mrs. Kennedy was more intentional about it.

Both Mrs. Kennedy and Mrs. Benedict incorporated whole group time in their lessons. Mrs. Kennedy’s class sizes were so small, however, that her whole group numbers actually more closely resembled small groups in Mrs. Benedict’s class. Mrs. Benedict incorporated large group discussions into her teaching, but a majority of the lesson time was handled in small groups of four to eight during the center times.
On the topic of student choice, Mrs. Benedict allowed more student choice than Mrs. Kennedy. Mrs. Kennedy taught structured lessons in which she expected the students to participate, at least at the beginning of them. She worked hard to maintain the 45-minute, two times per week time frame we had established at the beginning of the study. I always felt that, even when I was not there to observe, she was teaching science. Part of this was because I saw evidence of prior science learning on charts and illustrations on the science bulletin board. Mrs. Benedict had all of the children participate in the whole group discussions, but the center time was largely the student’s choice. Students could move from one center to another freely as long as there was space. She told me at the beginning she would encourage the students who were assessed at the beginning of the study to visit the science center during the week, but I did not see evidence of it being documented. So Mrs. Benedict allowed more choice than Mrs. Kennedy, but this might have affected the amount of time the students spent learning science.

At the beginning of the study, we had established that the Open Exploration timeframe would take four weeks and the Focused Exploration four weeks. Mrs. Kennedy seemed eager to move from Open Exploration to Focused Exploration, and she did this after the third week of the curriculum implementation. I did not discourage this, as I felt it was a teacher choice and the study was designed to examine teacher choices. She mentioned in her interviews that she felt more comfortable with the Focused Exploration. Mrs. Benedict, on the other hand, was not as quick to move from Open to Focused Exploration. She spent two more weeks on the Open Exploration phase of the
curriculum than Mrs. Kennedy, moving to it one week later than what we had outlined. She seemed comfortable with the Open Exploration phase.

Both teachers chose to learn about animals during the Focused Exploration phase of the curriculum implementation. Mrs. Kennedy decided to do this before I had given her students the interest assessment. When I asked her about how she determined this, she answered that the students were more engaged when learning about animals during Open Exploration. I then assessed them, and my assessment results confirmed this. Mrs. Kennedy intuitively knew what the assessment showed: Her students were more interested in animals.

Mrs. Benedict also chose to cover animals during the Focused Exploration, but she waited until I had assessed her students before making this decision. The choice was made in similar ways, however, by both teachers. Both of them based it upon the students and their interests, not on what they themselves felt most comfortable teaching. Both of them were student-centered in this decision.

Both teachers moved into the Focused Exploration phase of the curriculum, and they handled it in similar ways. Both of them skipped the first two lessons, probably because I had already provided them with resources. Both of them skipped to the third step of the Focused Exploration, observing the animals up close, and both remained there for the duration of the study. While they both covered content, such as animal body parts and life cycles, neither of them followed the lesson plans intended for these topics. While they acknowledged the value of experimentation, both teachers admitted to finding answers to student questions with resources such as books. Mrs. Benedict realized this
and made a point that she needed to slow down and help the children figure out how to answer the questions first.

**Student Data** Both sets of students took the SLA pre and poststudy. Table VI.2 shows the means of the groups of students pre and post. I ran a t test at the beginning to check to see if a statistical difference existed between the students at Burris Preschool and Wright Preschool prestudy. The p-value of that test was .941, indicating there was not a statistical difference between the two groups of students at the beginning of the study.

On the pretest the students of Burris scored a mean of 4.71, while the students at Wright scored a mean of 4.82. These were very similar. On the posttest, however, there were larger differences. On the posttest the students of Burris scored a mean of 5, while the students at Wright scored a mean of 5.82. Although this may not look very different at first glance, the t test results indicated that there was not a statistical significance in the scores from Burris Preschool pre and poststudy, but there was a statistical significance for the Wright Preschool students pre and poststudy. While the means of both groups increased, the Burris Preschoolers’ mean increase was likely due to chance, while the Wright Preschoolers’ mean increase was not likely due to chance. The students at Wright Preschool improved on their ability to use science process skills at the end of the study in a statistically significant way.

On the PISCES attitude assessment, the students from Burris Preschool had a mean of 9.42, while the students from Wright Preschool had a higher mean of 10.31. The higher mean of the Wright students reflected they had more positive views about science. Additionally, the frequency distribution from Burris Preschool followed an
Table VI.2  Student Data for Mrs. Kennedy’s and Mrs. Benedict’s Classes.

<table>
<thead>
<tr>
<th>Student Data</th>
<th>Kennedy (N=7)</th>
<th>Benedict (N=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLA Pretest Mean</td>
<td>4.71</td>
<td>4.82</td>
</tr>
<tr>
<td>SLA Posttest Mean</td>
<td>5.00</td>
<td>5.82</td>
</tr>
<tr>
<td>Significance level pre to post</td>
<td>.689</td>
<td>.004</td>
</tr>
<tr>
<td>Student Interest Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plants</td>
<td>13%</td>
<td>32%</td>
</tr>
<tr>
<td>Animals</td>
<td>88%</td>
<td>64%</td>
</tr>
<tr>
<td>Both plants and animals</td>
<td>0%</td>
<td>4%</td>
</tr>
<tr>
<td>Questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedural</td>
<td>58%</td>
<td>53%</td>
</tr>
<tr>
<td>Curiosity</td>
<td>35%</td>
<td>39%</td>
</tr>
<tr>
<td>Unknown</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>PISCES Posttest Mean</td>
<td>9.43</td>
<td>10.31</td>
</tr>
</tbody>
</table>

approximately normal distribution, while the frequency distribution from Wright Preschool was negatively skewed. This negative skew indicated that a majority of the students at Wright Preschool scored highly on this assessment.

Although the sample sizes were very different for these two groups of students, I would have expected the smaller group of students to score higher on these assessments because their teacher-student ratios were lower. Had this happened, the students from Burris Preschool would have scored higher than those of Wright Preschool. I would have also expected the group that included kindergarten students to score more highly. The
sample from Burris Preschool included three kindergarten students, but the Burris scores were lower than the Wright scores. Therefore, I think the results reflected more dramatic differences. The students of Wright performed higher on both assessments despite their larger class size, higher teacher-student ratios, and younger students.

**Revisit Research Questions**

At this point, I will revisit the research questions and hypotheses. The overarching question of this study was the following: How do two different preschool teachers implement a packaged science curriculum? The specific research questions under this broad category were as follows:

1. What variations exist in how the teachers implement the curriculum?  
   -In what ways do the teachers follow the directions of the program? In what ways do they alter the directions of the program (attempts, changes, additions, omissions)?  
   -What teaching choices do the teachers make in relationship to science inquiry?
2. How do variations in curriculum implementation affect student science process skills (prediction, observation, investigation, using science tools) acquisition?
3. How do variations in curriculum implementation affect student attitudes towards science?

The first hypothesis was as follows:

**Hypothesis 1:**

Different preschool teachers will implement a packaged science curriculum in a variety of ways, depending upon their comfort level teaching science and their philosophies regarding science inquiry.
This hypothesis was supported by the data. Mrs. Kennedy was initially more comfortable with science instruction and inquiry, while Mrs. Benedict was not quite as comfortable. The teachers started out with different comfort levels, and they implemented the curriculum in different ways.

Hypothesis 2:
Teachers with an initial higher comfort level teaching science will implement the curriculum making more personal teaching choices.

This hypothesis was not supported by the data. When looking at the initial quantitative surveys regarding the teachers’ beliefs about science instruction and inquiry teaching, I would have expected Mrs. Kennedy to make more personal teaching choices. She had higher scores on the STEBI and the Inquiry Teaching subscale than Mrs. Benedict at the beginning of the study. When looking at the observational data, however, Mrs. Kennedy actually made more attempts to follow the curriculum than omissions, while Mrs. Benedict had roughly the same number of attempts as omissions.

Hypothesis 3:
Teachers who value science inquiry will feel freer to make adjustments to the curriculum.

This hypothesis was difficult to prove, but it seems to be unsupported by the data as well. Mrs. Kennedy scored higher on the Inquiry Teaching subscale at the beginning of the study than Mrs. Benedict, but she adhered more closely to the curriculum.

Hypothesis 4:
In classrooms where teachers utilize more inquiry activities, students will show more gains in science process skills.
This hypothesis was supported by the data. Mrs. Benedict utilized higher levels of inquiry in her lessons, as all of her lessons fell into the guided inquiry category. A majority of Mrs. Kennedy’s lessons followed the structured inquiry designation. Only Mrs. Benedict’s students’ scores increased in a statistically significant way on the SLA Posttest. Her method of having the children freely explore may have helped them develop their process skills.

Hypothesis 5:
In classrooms where teachers utilize more inquiry activities (implement the curriculum more freely, making their own choices when necessary), students will reflect more positive views of science.

This hypothesis was also supported by the data. Mrs. Benedict made more curricular modifications than Mrs. Kennedy. While both groups of students had positive views of science, Mrs. Benedict’s class mean on the PISCES was higher than Mrs. Kennedy’s class mean. Although other teacher variables may have influenced this as well, her students may have benefitted from the way she freely made choices regarding the curriculum implementation.

Limitations of the Study

This study had limitations which make it difficult to generalize the findings. The main limitation of this study was the sample used. First, the students involved in the study were children of parents who could afford a tuition-based preschool program. None of them received any scholarship assistance, so the socio-economic status of the families enabled them to pay tuition for their children to attend preschool. These same parents may have had a commitment to early childhood education, as evidenced by the
fact that they enrolled their children in these preschool programs which were not compulsory. Additionally, the participating students were mostly Caucasian, so there was little ethnic diversity in the group. These limitations made it difficult to generalize the findings to the larger early childhood population.

Another limitation was sample size. The sample sizes for the students were small. Having only 7 students from Burris Preschool and 17 students from Wright Preschool made the conclusions tenuous. It was difficult to make inferences based on a t test with such small samples of students.

The teachers who participated in this study were a volunteer sample. At the beginning of the study, nine teachers had the opportunity to be a part of the study. Only two felt they could fully implement the curriculum. Mrs. Kennedy and Mrs. Benedict may have deviated from the norm in several ways. They may have been more willing to try a new curricular program, they may have been more committed to science instruction, and they may have felt more comfortable with having an observer present for their lessons. These factors all make the two teachers involved in this study unique. Therefore, it was difficult to generalize the findings to a larger population of teachers.

The novelty effect may have come into play during the study. When this occurs, participants give artificial responses “merely because a novel stimuli is introduced into the environment solely for the purpose of collecting data (e.g., a video camera)” (Onwuegbuzie & Leech, 2007, p. 236). Therefore, the teachers may have taught differently simply as a result of my observing and videotaping their lessons. Additionally, the teachers may not have felt entirely comfortable sharing their full reactions to the curriculum implementation. I had developed a positive rapport with both
teachers, and I think they felt very thankful I had provided them with materials, resources, and training. Although they did share some weaknesses they perceived, they may not have felt that they could completely share their true feelings.

One of my reasons for not administering the PISCES prestudy was because Patrick et al. (2009) did not do this in their study of kindergarten students. They questioned whether or not pretesting students about their science motivation was beneficial since a majority of children do not understand what science means when they start kindergarten. However, had I administered a pretest of the PISCES, I would have had better comparative data. It would have been interesting to see how the students’ attitudes towards science changed during the course of the study. As it was, it was interesting to see the descriptive data poststudy, but more information could have been gained by administering the PISCES pre and poststudy.

Last of all, one of the teachers participating in the study was a teacher I have worked with before. When that occurs, there is always the chance that the results will be biased. I addressed this in two ways. First, I looked carefully at both the quantitative and qualitative data to make sure they converged. Second, I had another Ph.D. candidate score complete the Observational Scale for three lessons. Although I knew and liked that teacher, I also developed a good rapport with the other teacher I did not know before the study began. I would have liked to see results that reflected statistically significant results for all of the students, but this did not happen. By using quantitative data, I was able to reduce the bias inherent in including a participant I already knew.

The last limitation lies in the low inter-rater reliability (69%) of the Curriculum Implementation section of the Preschool Science Lesson Observational Scale. While I
tried to establish 80% inter-rater reliability on this instrument, it did not occur on that subscale in this study. I feel that, had time allowed, better inter-rater reliability could have been achieved, especially since the inter-rater reliability of the instrument was over 80% when Ringwalt et al. (2010) calculated it in their study. However, the reality was that it was not. Therefore, the results gained on that section on the instrument should be viewed with caution.

Future Research

This study gave me much to contemplate in terms of future research. For this study, the teachers were given free reign to implement the curriculum the way they wanted to implement it. I was interested in finding out how their choices affected their students’ learning, and so I had to enable them to make choices by not prescribing what they should do. A future study, though, might involve one teacher who agreed to fully implement the curriculum with fidelity, following all of the components in the program. Then the other participating teachers could make their own choices regarding the curriculum. It would be interesting to see which teachers had better results in terms of their students’ process skills and attitudes.

Investigating science content knowledge would be enlightening. Since early childhood teachers feel uncomfortable with their science content knowledge (Forbes & Davis, 2008; Gilbert, 2009; Kallery, 2004; Kallery et al., 2009; Lewthwaite & Fisher, 2005; “Start Science Sooner,” 2010), examining this construct could help determine how their content knowledge affects their science instruction. It would also be useful to assess the students’ content knowledge. This could be done as a pre and posttest. Although I
focused on process skills for this study, I felt that one of the student groups would have performed well on a content-based assessment.

Student questions were tallied and analyzed for content. As I watched the DVDs and transcribed the students’ questions, I noticed that the teachers asked a lot of questions, too. A future study could categorize teacher questions to see if the teachers asked more open-ended or closed-ended questions of the students. A researcher could examine those types of questions, look at the overall levels of inquiry, and determine if a connection existed between them.

I would be interested in conducting this study in a preschool where the students were enrolled for the same amount of time. Going to a preschool with a Monday/Wednesday and Tuesday/Thursday class breakdown would have mitigated the problems with the samples. For instance, if the children all attended for half days, two days a week, this would have controlled for variables more effectively. Also, including children of more diverse ethnicities and socio-economic levels would have added to the generalizability of the study.

**Synthesis**

This study offered food for thought of ways to support early childhood teachers in their science teaching development. These teachers encounter many challenges in trying to implement science instruction in their classrooms. One challenge many early childhood teachers science teachers face is the issue of time (Burgess et al., 2010; Penuel et al., 2009). This issue was evident in this study. It manifested itself first by virtue of the fact that, out of nine teachers who had administrative support for using the curriculum, only two felt that they could participate in it fully. Additionally, Mrs.
Benedict shared several times in her interviews, both prestudy and poststudy, that time was a limiting factor in doing what she needed to do. In a busy school day with a focus on literacy and numeracy, how can a teacher include science instruction?

Looking at how the two teachers in this study found time to include science can help trainers enable teachers to find ways to teach science. Mrs. Kennedy had a natural interest in science, and she valued it as a subject. “The way we feel intrinsically about a subject strongly influences our teaching of the subjects. We devote more time to it and we teach it more passionately” (Lewthwaite & Fisher, 2005, p. 595). Mrs. Kennedy brought science ideas to her preschool and initially stated that she felt she needed to include more science in their school day. When the study began she was able to schedule 45 minutes of science instructional time in each day. I think that her belief that science was important helped her prioritize it. It is important to figure out ways educators can realize the value of science instruction. If a teacher believes that a subject is important, he or she will make the time to teach it. Early childhood science educators must find ways to present reasons why science is important to other educators through conferences and inservice training. If teachers can be helped to see that science is naturally engaging to the students, that it taps into their natural curiosity, and that it helps them develop thinking skills that will help them in all subjects, they will realize that including it is vital. Teachers of young children need to be given opportunities to see science instruction in practice, because looking at how the students respond to strong science instruction will help them realize how beneficial it can be for their students.

Mrs. Benedict had another way of handling her time issues. She used her already scheduled circle times, center times, and recess times to do her lessons. She primarily
used the circle times for whole group discussion, review, and instructions for the centers. She used the center time to enable the children to freely explore the science equipment, materials, and creatures. Last, near the end of the recess time, she pulled small groups of children from the group and explored the environment outside with them. Helping teachers look at what they are already doing and showing them that they can fit science instruction into their predetermined schedule can help them realize the following: It is possible to include science instruction without scheduling an isolated time for it.

Another way of helping teachers overcome the time issue is to integrate science instruction into other subject areas. Several times Mrs. Kennedy used the end of her allotted science time to allow the children to freely explore books, which helped them develop their literacy skills. She also helped them count the body parts of the insects, connecting science and math. Mrs. Benedict integrated science into other areas, too. When her class studied crickets, she brought in Eric Carle’s book, *The Very Quiet Cricket*, and shared it with the students. Reading this book enabled them to think about the sounds the crickets made. It may have sparked the experiment they conducted when they changed the environment to try to get the crickets to make sounds. Mrs. Benedict also used the Science Around the Room activity as an extension of Reading Around the Room and Writing Around the Room. Since the children were already familiar with those activities, it was easy for them to transfer them to science. By drawing and labeling the living creatures they found in their classroom, they exercised their reading and writing skills. The *Young Scientist Series* offers the teacher enough freedom and flexibility to find ways to integrate other subjects into the curriculum.
Time can also be related to gathering resources in order to teach hands-on science. Sometimes teachers may not feel that they have the time to look for materials or the money to pay for them. Providing them with simple lists of the types of materials they can find at regular stores can also enable them to see how easy it is to find these materials. All a teacher needs to help the children explore mealworms is a container of the worms, food for the worms, and a piece of a small water-soaked sponge. The containers of mealworms were inexpensive, and they have provided the teachers and students with interesting activities over an extended time period. In fact, Mrs. Benedict kept the container of mealworms after the study concluded, and the students were able to observe the mealworms moving into the pupa and adult stages of their life cycles. It is also important to help teachers look at what they already have in their environments that they can use. Mrs. Kennedy was particularly effective at this. She brought in different kinds of seeds during the Open Exploration phase, and these seeds did not cost her any money. During inservice trainings, teachers can brainstorm together what items from their environment they can use. The Preschool Classroom Science Materials/Equipment Checklist had many items that teachers already have in their classrooms. Seeing these items listed on a science materials checklist can help them think creatively about how to use everyday materials.

Another problematic topic for teachers is a lack of confidence with subject matter. Many early childhood teachers do not feel confident in their abilities to teach science because they do not think they have strong enough content knowledge (Forbes & Davis, 2008; Gilbert, 2009; Kallery, 2004; Kallery et al., 2009; Lewthwaite & Fisher, 2005; “Start Science Sooner,” 2010). Although this study did not specifically address teacher
content knowledge, several ideas for addressing this issue did emerge. First, teachers have more science content knowledge than they realize. Many of them have had science courses in their schooling, and many have had informal science experiences. Tapping into these experiences and helping teachers realize they have more knowledge then they realize is paramount to helping them develop confidence in their science teaching.

During trainings, having teachers list all of the science experiences they have had in their lives and sharing them would help them see that they know more than they realize. It would also be helpful to have teachers brainstorm ideas of how they can handle questions to which they do not know the answers. The key word here is inquiry.

If early childhood teachers understand the inquiry process, even if they do not feel comfortable with science content, they can teach science more effectively. The key is helping them use the process they will use with their students to enhance their own knowledge. They can formulate questions about the topics on which they have less knowledge. Then they can formulate investigations, make observations, collect data, and share with others what they have learned. If teachers can shift their teaching identity to that of being a facilitator and learner along with their students, they can guide their students through the inquiry process successfully. Vygotskian theory supports this view of teachers and students co-constructing knowledge together (Roopnarine & Johnson, 2009). Mrs. Benedict demonstrated this. She felt uncertain about her ability to teach science at the beginning of the study, but gained confidence as the study progressed. She explored the science materials and creatures alongside the students, modeling her thinking to them. I often heard her say, “I wonder what would happen if,” which is at the heart of the inquiry process. Teachers do not have to be science content experts to teach
early childhood science effectively, and if they realize this, they can be freed to explore
science topics along with their students.

In order to do this, the teacher needs to think of her or his role in an inquiry-based
classroom. If teachers can start viewing themselves as facilitators of learning instead of
impacters of knowledge, their teaching can shift to become more constructivist in nature.
For some teachers, this may be difficult. For instance, Mrs. Kennedy knew a lot about
science, and she enjoyed sharing that knowledge with her students. She wanted to
answer questions when they arose. Helping the teacher make a simple shift from telling
to asking would help that teacher make a subtle shift towards a more student-centered
classroom. For instance, when a child asks a question, instead of answering it, the
teacher can shift the focus back to the student and elicit that student’s ideas. Asking the
child, “What do you think” or “How can we find out?” is a simple way to enable students
to become more actively involved in constructing their own knowledge. Providing
teachers with open-ended teaching stems, such as those above, would help them see how
they can shift their thinking about their role with the students.

From a Vygotskian perspective, knowledge is created through social interactions
between students and teachers (Santrock, 2003). I saw this firsthand in Mrs. Benedict’s
classroom. She sat alongside the students and modeled her wondering out loud. She also
asked questions such as, “How could we find out?” Her students not only interacted with
her, they also shared their observations with each other. The engaged interactions
between students as they made observations and shared them with each other likely
enabled them to construct and retain the knowledge.
Helping teachers implement curriculum is also an important component of helping them teach science effectively. It is important to select a program that provides questions instead of answers. It is also vital that the curriculum provide the teacher with some flexibility for implementation. For instance, one basis of inquiry is allowing the students to ask questions and formulate investigations. Therefore, a scripted curriculum seems at odds with the nature of inquiry science instruction. If a teacher has a strong, inquiry-based science curriculum, she or he can use that to help make sure the students are learning. In this study, I played the role of researcher, not of coach. If I were a coach, I would take a different role in helping the teachers implement the curriculum. In my opinion, some important components of the curriculum were omitted by both teachers. Both groups of students would have benefitted with more outside exploration and more discussions at the end of the lessons, among other things.

In training the teachers, I would have had them select what they felt were the essential components, or heart of the program. Then as I observed them, I would point out when I saw these components included or left out. I think that if teachers understand why a certain component of a lesson is included, they will be more likely to include it. For instance, brainstorming what students can learn about nature by going outside on a snowy day might help teachers see that cold weather does not have to hinder outside science exploration. Talking about the importance of verbal processing would help them understand why it is important to include discussions at the ends of the lessons to help the students share their thoughts and observations with each other, which is a component of the inquiry process.
If a teacher like Mrs. Kennedy felt uncomfortable with less structured activities, I might play a point-counterpoint discussion between that teacher and others. That teacher could come up with ideas why providing more open-ended activities would benefit the students, while the other teacher could talk about her need for a lesson plan. I think that openly discussing these issues would help the teacher realize that these open-ended activities could benefit the students. Mrs. Kennedy, while she felt more comfortable with a structured lesson plan, also realized at the end of the study that she needed to learn more about Open Exploration. Having conversations about these issues would help the teachers gain insight into why they make the choices they do.

Most of the challenges of teaching science in early childhood can be handled using inquiry methods with the teachers. In inservice trainings, teachers can be provided with ideas of questions they can work to answer, such as the following:

- Why teach science in early childhood?
- Even if I want to teach science, how can I figure out how to do it with limited time and resources?
- How do we know that teaching using inquiry is more advantageous for the students?
- What are some simple things I can do to help me view myself as a facilitator instead of imparter of knowledge?

In closing, it is important to help early childhood teachers understand the importance of science instruction and offer them ideas of how they can face the challenges of limited time, resources, and insecurity about their own knowledge. Helping them view their role as a learner alongside the students instead of an expert imparting
knowledge is crucial. Teachers need opportunities to engage in inquiry themselves, including chances to communicate with each other about their experiences and observations. Providing these opportunities can help teachers increase their effectiveness through inquiry, the method that is advocated for use with their students (Aulls & Shore, 2008; Chiapetta, 2008; Eshach, 2006; Saracho & Spodek, 2008; “Start Science Sooner,” 2010).

Conclusion

The purpose of this study was to examine how preschool teachers’ implemented a science curriculum with their students. It specifically investigated how their choices in implementation regarding components of the lessons and levels of inquiry affected their students’ process skills and attitudes towards science.

Although this study had limitations, most notably the samples used, some rich information was gained from it. The two teachers were both committed to science instruction and students. They were both willing to implement a new curriculum and participate in videotaped observations of half of their lessons. Both were positive teachers with an attitude of wanting to continue to learn themselves.

Mrs. Kennedy was very comfortable with science and inquiry at the beginning of the study. Her views of science did not change during the course of the study. Her views of inquiry actually declined, though they were still positive. When she implemented the curriculum, she made more attempts to follow what was in the teachers’ guide than Mrs. Benedict. Her lessons included the whole group in her small classes. When looking at inquiry, her lessons most often followed a structured format. Mrs. Kennedy’s students
did not show significant gains in their process skills. On the PISCES, they had positive views of science, but not overwhelmingly so.

Mrs. Benedict started the study more tentatively in terms of her comfort level with science and inquiry at the beginning of the study. She grew in both her views of science and her views of inquiry at the end of the study. When she implemented the curriculum, she made roughly the same number of attempts as she did omissions. Most of the science in her classroom was taught in small groups at centers where she facilitated the learning of the students. The level of inquiry she utilized was guided inquiry throughout all of the lessons. At the conclusion of the study, Mrs. Benedict’s students scored significantly higher when assessed on their science process skills. The attitude assessment also reflected positive views of science, as the majority of her students scored highly on the PISCES.

Examining the data at face value, it appears that a teacher does not have to follow a curriculum strictly in order to help the students learn and enjoy science. Mrs. Benedict followed the curriculum less closely than Mrs. Kennedy, and her students showed larger gains in their process skills and higher scores on their attitude assessment. They also benefitted from a level of inquiry that was more guided than structured.

Preschool teachers have a unique opportunity to help their children start on a lifetime journey of science instruction. Although even preschool teachers face time constraints, these are not as rigid as those the teachers of older students experience. It is my hope that the findings of this study will help early childhood teachers realize how important science instruction is for their students and prioritize it in their schedules. Science is more than a subject, it is a way of thinking. Being able to use process skills to
solve problems is a skill that all of our students need to exercise and hone, and science offers the perfect route to achieving this goal. There is no better time to start meaningful science instruction than in early childhood.
APPENDIX A

DEMOGRAPHIC BREAKDOWN OF BURRIS AND WRIGHT ELEMENTARY SCHOOLS.
Figure A.1 Demographic breakdown of Burris and Wright Elementary Schools (kindergarten through fifth grade students).
APPENDIX B

SCIENCE TEACHING EFFICACY BELIEF INSTRUMENT
Science Teaching Efficacy Belief Instrument

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letter to the right of each statement.

SA= strongly agree
A= agree
UN= uncertain
D= disagree
SD= strongly disagree

1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort.
2. I am continually finding better ways to teach science.
3. Even when I try very hard, I don’t teach science as well as I do most subjects.
4. When the science grades of students improve, it is most often due to their teacher having found a more effective teaching approach.
5. I know the steps necessary to teach science concepts effectively.
6. I am not very effective in monitoring science experiments.
7. If students are underachieving in science, it is most likely due to ineffective science teaching.
8. I generally teach science ineffectively.
9. The inadequacy of a student’s science background can be overcome by good teaching.
10. The low science achievement of some students cannot generally be blamed on their teachers.
11. When a low achieving child progresses in science, it is usually due to extra attention given by the teacher.
12. I understand science concepts well enough to be effectively in teaching elementary science.
13. Increased effort in science teaching produces little change in some students’ science achievement.
14. The teacher is generally responsible for the achievement of students in science achievement.
15. Students’ achievement in science is directly related to their teacher’s effectiveness in science teaching.
16. If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child’s teacher.
17. I find it difficult to explain to students why science experiments work.
18. I am typically able to answer students’ science questions.
19. I wonder if I have the necessary skills to teach science.
20. Effectiveness in science teaching has little influence on the achievement of students with low motivation.
21. Given a choice, I would not invite the principal to evaluate my science teaching.
22. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.
23. When teaching science, I usually welcome student questions.
24. I don’t know what to do to turn students on to science.
25. Even teachers with good science teaching abilities cannot help some kids learn science.

(Riggs & Enochs, 1990)
APPENDIX C

ATTITUDES AND BELIEFS ABOUT SCIENCE QUESTIONNAIRE
INQUIRY TEACHING SUBSCALE
1=strongly disagree  2=disagree  3=agree  4=strongly agree

1. I feel uncomfortable teaching scientific inquiry.
2. The teaching of the inquiry process is important.
3. I fear that I will be unable to teach inquiry adequately.
4. Teaching inquiry takes too much time.
5. I enjoy using experiments during my science lessons. (adjusted for ECE with permission of the author)
6. I have a difficult time understanding science.
7. I feel comfortable with the science content in my curriculum.
8. I would be interested in working in an experimental science curriculum.
9. I am not afraid to demonstrate science phenomena in the classroom.
10. I am willing to spend time setting up equipment for an experiment. (adjusted for ECE with permission of the author)
11. I am afraid that students will ask me questions that I cannot answer.
12. Science is as important as the 3 R’s.
13. I enjoy manipulating science equipment.
14. In the classroom, I fear science experiments won’t turn out as expected.
15. Science would be one of my preferred subjects to teach if given a choice.
16. Teaching inquiry takes too much effort.
17. Children are not curious about scientific matters.
18. I plan to integrate science into other areas.
19. Field experiences are not necessary in teaching science.

Used with permission by the author, Karen Johnson, Ph.D. (Johnson, 2004)
APPENDIX D

PRESCHOOL SCIENCE CLASSROOM MATERIALS/EQUIPMENT CHECKLIST
# Preschool Classroom Science Materials/Equipment Checklist

**Date____________________________**

**School__________________________**

**Classroom_______________________**

## Science Materials
- **Aquarium**
- **Books**
- **Flashlights**
- **Living animals**
- **Magnets**
- **Magnifying glasses**
- **Metric balance**
- **Microscope**
- **Mirrors**
- **Outdoor garden**
- **Planting materials**
- **Plants**
- **Posters/chart** (i.e. life cycle, squirrel vs. chipmunk, etc.)
- **Puzzles**
- **Scales**
- **Sensory table**
- **Thermometers**
- **Videotapes/DVDs**
- **Vinyl animals**

## Science Equipment
- **Binoculars**
- **Candles**
- **Cardboard tubes**
- **Coffee cans**
- **Egg cartons**
- **Egg timer**
- **Flower pots**
- **Food coloring**
- **Funnels**
- **Latches**
- **Locks and keys**
- **Measuring cups and spoons**
- **Milk cartons**
<table>
<thead>
<tr>
<th>Item</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old sheets and pillowcase</td>
<td></td>
</tr>
<tr>
<td>Pitchers</td>
<td></td>
</tr>
<tr>
<td>Plastic jars and containers</td>
<td></td>
</tr>
<tr>
<td>Potting soil</td>
<td></td>
</tr>
<tr>
<td>Prisms</td>
<td></td>
</tr>
<tr>
<td>Pulleys</td>
<td></td>
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<tr>
<td>Rubber tubing</td>
<td></td>
</tr>
<tr>
<td>Rulers</td>
<td></td>
</tr>
<tr>
<td>Small cages</td>
<td></td>
</tr>
<tr>
<td>Sponges</td>
<td></td>
</tr>
<tr>
<td>Spools</td>
<td></td>
</tr>
<tr>
<td>Tape measures</td>
<td></td>
</tr>
<tr>
<td>Yarn</td>
<td></td>
</tr>
<tr>
<td>Bird's nests</td>
<td></td>
</tr>
<tr>
<td>Dried flowers</td>
<td></td>
</tr>
<tr>
<td>Feathers</td>
<td></td>
</tr>
<tr>
<td>Fossils</td>
<td></td>
</tr>
<tr>
<td>Gourds</td>
<td></td>
</tr>
<tr>
<td>Insects</td>
<td></td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td></td>
</tr>
<tr>
<td>Pine cones</td>
<td></td>
</tr>
<tr>
<td>Plants</td>
<td></td>
</tr>
<tr>
<td>Seashells</td>
<td></td>
</tr>
<tr>
<td>Other Items</td>
<td></td>
</tr>
</tbody>
</table>

APPENDIX E

QUESTIONS FOR TEACHER INTERVIEWS
Questions for Teacher Interview #1

Describe how you taught science, if at all, last year.
Please share how you feel when a supervisor hands you a packaged curriculum and tells you to start implementing it.
When you teach a lesson from a pre-packaged curricular unit, describe the process you go through in deciding what to do, change, or leave out of the lesson.
What is your understanding of what inquiry science means?

Questions for Teacher Interview #2

Describe the process you went through to implement this curriculum.
Tell me the strengths of this curriculum.
Share with me what you think the weaknesses are of this curriculum.
In general, how did the students respond to the lessons?
What is your understanding of what inquiry science means?
How did you decide which focused exploration to teach?
What’s your opinion of the level of inquiry shown in this program?
What do you feel about its appropriateness for preschoolers?
APPENDIX F

SCIENCE LEARNING ASSESSMENT ITEM DESCRIPTIONS
Science Learning Assessment Item Descriptions

Name_____________________________

Date____________________________

(Assessor: Highlight or circle the child’s answer. Correct answers are in italics.)

1. Here are pictures of three children (show pictures): (a) James practices dancing;  
(b) Tom plays the guitar; (c) Gina observes a butterfly.

Which of these children is doing science?

2. Here is a picture of a frog (show picture). These girls ask questions about the frog  
(show pictures). Listen to each question and tell me which girl asked a science  
question: (a) What does this frog eat? (b) Do you like this frog? (c) Can I call this frog Lilly?

3. Here is a picture of a fish (show picture of black and white striped fish). Here are  
three boys (show pictures). I will tell you what each boy said about the fish. (a) I  
have a pet goldfish at home; (b) That fish has black and white stripes; (c) Fish like to swim in groups.

Which of these boys saw the fish in this picture?

4. Here is a picture of a ball (show picture of red ball at rest). Here are three girls  
(show pictures). I will tell you what each girl said: (a) This ball can bounce; (b)  
This ball is red; (c) My dress is green.

Which of these girls made a prediction about the ball?

5. Terri, John, and Jenny are on the playground (show picture: John and Jenny are  
on the teeter totter. Terri is sitting on the middle of the teeter totter.). Listen to
what each child says. Then tell me which child makes a prediction about the
tee ter to ter: (a) Jenny says, “I am having lots of fun.” (b) John says, “I want to
go up, Jenny.” (c) Terri says, “If I push down on Jenny’s side, John will go up.”
Which of these children made a prediction about the teeter totter?

6. (Show pictures) Two girls found an egg. The girl in polka dots thinks it is a duck egg. The girl in the pink jacket thinks it is a goose egg. How can they find out what it is? (correct answer: watch it hatch/study its shape, color, etc.; partially correct answer: ask expert)

__________________________________________________________________
__________________________________________________________________
________________________

7. Here are some tools we use to do science (show items): Which of these can help you figure out what plant or animal you saw outside? (a) Thermometer ; (b) Field guide; (c) Stopwatch.

8. Here are some tools we use to do science (show items): Which of these can you use to look at something very small such as a bug? (a) Digital scale; (b) Rain gauge; (c) Magnifying glass.

9. Here are some tools we use to do science (show items): Which of these can you use to carefully dig up a plant? (a) Trowel; (b) Penlight; (c) Pan scale.


Items 7, 8, and 9 modified by Shamas-Brandt to accommodate the specific curriculum being taught.
APPENDIX G

TRAINING SESSION 1
Training Session 1-The Young Scientist Series (2 hours)

-Give out teacher’s guide and talk about how we’ll go through it.

-Guiding Principles- Hand out and talk through.


-Show Vignette #1 and discuss.

-Previous nature experiences.

-Do chart “What We Think We’ll Find Outside/Where We Think We’ll Find Them.”

-Go outside.

-Discussion about what was discovered.

-Look at Inquiry handout. How did they use inquiry in their outside investigations?

- Introduce Science Concepts handout.

-Do reflection page.

-Discuss the outdoor environment.

-Prepare the indoor environment. (Directions for terrariums are on page 123 of Teacher’s Guide.)

-Do the roundabout with different environments.

-Open Exploration- handout.

-Vignette #2 with observation form.

-Needs.

Share bins. (pages 16-17 of Teacher’s Guide)

Discuss scheduling issues.

-Parent consent forms.

-Questions.
APPENDIX H

PRESCHOOL SCIENCE LESSON OBSERVATIONAL SCALE
Preschool Science Lesson Observational Scale

Lesson Title________________________________________________________

Date__________________________________________

Curriculum Implementation
(Tally each instance observed during the lesson.)

Content

Attempts ________________________ Total________

Changes ________________________ Total________

Omissions______________________ Total________

Additions______________________ Total________

Methods

New methods_________ Total________

Student Questions

Procedural______________________ Total________

Curiosity______________________ Total________

Levels of Inquiry

<table>
<thead>
<tr>
<th>Level</th>
<th>Problem/Question</th>
<th>Procedure/Method</th>
<th>Solution</th>
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<tbody>
<tr>
<td>0</td>
<td>provided to student</td>
<td>provided to student</td>
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</tr>
<tr>
<td>1</td>
<td>provided to student</td>
<td>provided to student</td>
<td>constructed by student</td>
</tr>
<tr>
<td>2</td>
<td>provided to student</td>
<td>constructed by student</td>
<td>constructed by student</td>
</tr>
<tr>
<td>3</td>
<td>constructed by student</td>
<td>constructed by student</td>
<td>constructed by student</td>
</tr>
</tbody>
</table>
Structured Inquiry:
Although this employs hands-on activities, it is mostly teacher led. For example, a question or problem would be posed to students. Students may be given a worksheet to complete, directions, and materials to complete the activity. The outcome may be stated at the outset (“We’re going to learn how to make foam today.”).

Guided Inquiry:
This uses hands-on activities. There is a balance between teacher-led and student-led activities. The teacher might pose the problem, and the students might devise ways to solve it. Or the students might pose a problem, and the teacher might facilitate the students figuring out how to solve it.

Full Inquiry:
This uses hands-on activities, but is basically student-led. Students are in charge of developing questions and figuring out how to answer them. The teacher facilitates and helps the learners in their quest for knowledge.

Into which level of inquiry did the lesson as a whole fall?

Definitions
Attempts: Whether or not the teacher attempted each step in each lesson. The smallest unit of instruction completed “for which there were specific goals, concrete instructions for teachers to follow, and specific prompts for student-centered answers.”

Content adaptations: Adaptations to the substantive component of the material.

Changes: Any rewording of material as written, including modifications to statements, questions, or instructions (beyond simple rephrasing). This includes alterations to content, but does not include modifications involving the teaching method or strategies.

Omissions: Any deletion of content within a step.

Additions: Any new material presented not specified in the curriculum.

Teaching method adaptations: The instructional strategies by which the content was delivered to students.
New methods: Whether or not new strategies were used during the delivery of the material in each step. Any change in teaching strategy as prescribed by the curriculum. (Ringwalt et al., 2010)

Examples of Types of Questions

Procedural

Which soap do we use?
Shall we add more soap?
How much water did you add?
Can we have more time?

Curiosity

What makes bubbles?
What would happen if we changed the water temperature?
Why do the dowels have points?
What would happen if you baked a cake with shaving cream?

(Yager et al., 2005)
APPENDIX I

PRESCHOOL STUDENT INTEREST ASSESSMENT
Preschool Student Interest Assessment

Name________________________________________

Date________________________________________

School_______________________________________

Class________________________________________

1. Place an index card with a smiley face on one side and one with a frown on the other. Give student a pile of pictures, 2 of plants and 2 of animals. Say, “Please put the pictures you like by the smile and the things you don’t like by the frown.” (Circle child’s responses.)

   Ant ☺ ☹
   Flower ☺ ☹
   Butterfly ☺ ☹
   Tree ☺ ☹

2. Spread out the pictures the child selected above. Say, “Please point to your favorite.” (Write child’s response.)

3. What do you want to keep learning about? (Show a picture of a plant and a picture of an animal.)

   plant animal (Circle child’s response.)

4. Which book would you like to read more? (show two books, one about plants and one about animals)

   book about plants book about animals (Circle child’s response.)

5. Which would you rather talk to a friend about? (Show a picture of a plant and a picture of an animal.)

   Show picture of animal Show picture of animal (Circle child’s response.)

APPENDIX J

TRAINING SESSION 2
Training Session 2-The Young Scientist Series (1 1/2 hours)

-Discuss Open Exploration.

-Focused Exploration of mealworms.

-Introduce- observe, think about questions, and take notes.

-Discuss-2-3 observations and 2-3 questions (“We Notice…” and “We Wonder…” charts).

-Continue-go over activity instructions.

-Process again-categorize questions (O-observation, E-experiment, S-through sources)

-Resume-select question to be answered by observation or simple experiment (“What We Learned About Mealworms” chart). Observe, listen, encourage, suggest questions.

-Discuss chart and teacher’s role

-Review inquiry diagram. What inquiry skills have the children been using?

-Purpose of Focused Exploration-Overhead 5.1.

-How did the mealworm activity exemplify Focused Exploration?

-How was that different from Open Exploration?

-Elements of Focused Exploration (How could these be carried out over the course of a year?)

-Transition from Open Exploration to Focused Exploration (connect to 5.1)

-Show vignette and discuss.

-Look at Teacher’s Guide-discuss choices of Focused Exploration and choices within Focused Exploration.

-Conclusion

-materials
-two 45-minute periods of science per week

-remind them that all children present during videotaping must have parent consent forms.
APPENDIX K

PUPPET INTERVIEW SCALES FOR COMPETENCE IN AND ENJOYMENT OF SCIENCE (PISCES)
Administration

The child is shown five ethnically diverse puppets. The researcher will explain that the puppets will talk about things that happen in school and ask the child to choose a puppet that is most like her/him. The child then will name the puppet and make a nametag for the puppet with the researcher’s help. The researcher then will select a second, identical puppet to the one the child selected and say:

“Here is another child just like you and ______ (Puppet 1). He/she is a friend of ______ (Puppet 1). Let’s give him [her] a name. What would you like to call him [her]? Ok, he [she] is ______. And here is his [her] name tag.

_______(Puppet 1) and _______ (Puppet 2) go to the same school and they have the same teacher. They have a teacher just like yours. They will talk about themselves and what they like. They like different things, but that’s ok because they are different kids. It’s ok for different kids to feel differently.”


The children will be given two practice items (Puppet 1: “I like pizza”; Puppet 2: “I don’t like pizza”; Puppet 2: “I like recess in school”; Puppet 1: “I don’t like recess in school”) and asked, after each statement, “Which puppet thinks the same as you?”
Including these practice items will help make sure the children understand the format of the assessment before beginning. If children need more practice, it will be offered to them.

**PISCES**

Name_______________________________________Date___________________
School____________________________________________

**Questions (highlight or circle the child’s response)**

**Perceived Science Competence Subscale**

Puppet 1: I know how to do science.  
Puppet 2: I know how to use different science tools.  
Puppet 1: I don’t know very much about different kinds of living things.  
Puppet 2: I know a lot about different kinds of living things.

Puppet 2: I know a lot about science.  
Puppet 1: I do not know very much about science.

**Science Liking Subscale**

Puppet 1: I don’t like science.  
Puppet 2: I don’t like to draw science pictures.  
Puppet 1: I like using different science tools.

Puppet 2: I like science.  
Puppet 2: I like to draw science pictures.


Used with permission from Dr. Mantzicopoulos and Dr. Patrick.
APPENDIX L

CONSTANT COMPARATIVE ANALYSIS MRS. KENNEDY PRE INTERVIEW:
SCIENCE INSTRUCTION
Constant Comparative Analysis Mrs. Kennedy Pre Interview: Science Instruction

Chunks

We did, we’d have projects, um, depending on what our theme was, we would try and tie in a project

Uh, the big one that comes to mind is in the spring, we, I got some tadpoles, and I made a chart showing the life cycle of a frog

And we discussed and read books on all the life cycle and how that went,

and then we got to watch the actual frog, tadpoles turn, get their legs, their front legs first, no their back legs first, then their front legs

And most of them did not change all the way by the end of the year

But at least got to see and they were fascinated

They’d run to the tank every day and uh, look at it and see what was going on in there.

So it was a great project

For spring. I’m trying to think what other.

I don’t know if this is considered science,

but we, how many of these do you need to know

Codes

projects

tadpoles

discussed/read

tadpoles

watch

did not change

fascinated

watch

project

think
Um, we did Colorado and we made a cardboard box
and put Velcro on the inside, a big cardboard
box, like a refrigerator box, painted the outside
brown like it looked like a mine,
uh, then we would Velcro gold nuggets on the inside
and the kids would go we had um,
it was set up as a center,
and one of us would be there watching the kids go
in and mine gold.
They’d bring it out, and we’d have them put on a hard
hat, and a vest and uh, they loved that.
And then we had the second center was our water table
where we put, I put gold beads into sand and
we’d put it in there with water and the kids would have,
my husband’s a miner, well, he’s in geology,
so um, I have a pan, panning gold, and they would
learn how to pan gold for these beads that
were in the,
we had two centers, seems to me we had a third,
but I can’t recall which one it was.
Those are the two that come to mind
There were huge
Were huge
That they loved, loved

Um, probably, not as, I think not as much as we should have

In fact, at the end of the year I said, I think that we

should do a lot more science and ____________

told me you were um, gonna be coming into the

picture, and let’s wait and see

Um, but we, we need to do more

They love it

We try and do a little bit with each theme,

but I don’t think we do enough. To be honest

Grouping of Codes

projects (2) tadpoles discussed
center (3)/water table did not change read
theme mine watch
huge geology (think-she was)
fascinated pan gold

not as much (2)
do more
Emergent Theme Statement

Science was handled as projects or centers connected to themes, such as tadpoles or geology concepts (mining and panning for gold) where the children read, discussed, and watched to learn. These were huge projects the students loved that fascinated them. Science wasn’t taught as much as it should have been, and she thinks they need to do it more.
APPENDIX M

CONSTANT COMPARATIVE AND DOMAIN ANALYSES: MRS. KENNEDY PRE INTERVIEW: INQUIRY SCIENCE
Constant Comparative Analysis: Mrs. Kennedy Pre Interview: Inquiry Science

Chunks

Inquiry is asking questions
So to me it would be inquiry science is where the kids are enthused enough to ask a lot of questions as to what’s next and what happens after that And what happens, you know, how does it begin, middle, and end. Um, that’s what I would say inquiry science is. No.

Codes

questions

Grouping of Codes

questions

what happens

Emergent Theme Statement

Inquiry is where the kids ask questions about what happens.
### Semantic Relationship: Strict Inclusion

<table>
<thead>
<tr>
<th>Included Terms</th>
<th>Semantic Relationship</th>
<th>Cover Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking questions</td>
<td>is a kind of</td>
<td>inquiry science</td>
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<tr>
<td>Figuring out what happens</td>
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### Semantic Relationship: Spatial

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### Semantic Relationship: Cause-Effect

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### Semantic Relationship: Rationale

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### Semantic Relationship: Location for Action
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**Semantic Relationship: Function**

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**Semantic Relationship: Means-End**

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**Semantic Relationship: Sequence**

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**Semantic Relationship: Attribution**

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APPENDIX N

CONSTANT COMPARATIVE AND DOMAIN ANALYSES MRS. KENNEDY POST INTERVIEW: INQUIRY SCIENCE
Inquiry science would be finding out the questions that the children have about whatever it is you’re presenting to them, whatever the bug is, whatever the seed or whatever. Their inquiries you would do experiments to find out the answer to their questions. For their age level I would say.

Grouping of Codes

finding out questions experiments to answer age level

Emergent Theme Statement

Inquiry science entails finding out the students’ question and doing experiments to find the answers to them.

Domain Analysis Mrs. Kennedy Post Interview: Inquiry Science
### Semantic Relationship: Strict Inclusion

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APPENDIX O

CONSTANT COMPARATIVE ANALYSIS MRS. KENNEDY PRE INTERVIEW: CURRICULUM
**Constant Comparative Analysis Mrs. Kennedy Pre Interview: Curriculum**

**Chunks**

| I don’t have a problem with it as long as I have time to review it, get it in my mind how it’s gonna flow. | time |
| Um, and I do well with that, when I know that it, how it’s going to flow, then I can create the thing in the classroom | do well, flow |
| So I like to do that, um, as long as I have time to review it and get it straight. | time |
| How it’s gonna go. | how |
| It can’t pop on me, ‘cause I, I have to envision it first | envision |
| Well, I would, I would go on what, what I think the kids can handle | kids |
| Um, I would go on if if they’re young, I would probably try and make it a fit for a younger kids’, for their attentions span’s not as long | fit |
| Their um, fine motor skills aren’t as good | fine motor |
| Um, they’re not grasping as much as say a four-year-old | not grasping |
| And the five-year-olds even more | more |
| So I would, I would look at what the materials are and, then I would adjust it to their age | adjust |
| and, for instance I have one that’s…I wouldn’t, | |
she’s on an IEP so I would have to adjust it

for her to see what she could do.

And, and if there are advanced kids, then I would try

and go to the high end of whatever the package gives me

And let them, whatever their, what level they’re at,

that’s where I would try and take them.

But the main thing is dividing them up because

three-year-olds don’t can’t do a lot yet

It’s, it’s hard just to get ‘em to sit

I would probably, I’m more likely to follow it to the letter,

and then and then as time goes on adjust it to add

or you know, take away whatever

or whatever we’re on, if we’re on a theme for instance,

and if I can add that in I would probably do that.

Just to give it a little, uh, continuity. Is that what I mean?

Look for the word.

Anyway, that’s what I would do.

Grouping of Codes

<table>
<thead>
<tr>
<th>time (2)</th>
<th>do well</th>
<th>flow</th>
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<tbody>
<tr>
<td>follow</td>
<td>how</td>
<td>envision</td>
</tr>
<tr>
<td>adjust in time</td>
<td>envision</td>
<td>do</td>
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</table>
Emergent Theme Statement

This teacher does well if she has time to see how the curriculum flows and can envision how to go about teaching it. She considers if the activities are a good fit for her kids, considering what they can grasp, their fine motor skills, attention spans, and levels of learning. She divides the children by age and adjusts the curriculum to fit their needs, often connecting it to their theme to provide continuity. She tends to follow a curriculum closely at first, adjusting it as time goes on.
APPENDIX P

CONSTANT COMPARATIVE ANALYSIS MRS. KENNEDY POST INTERVIEW: CURRICULUM
Constant Comparative Analysis Mrs. Kennedy Post Interview: Curriculum Strengths

**Chunks**

I think it’s just so wonderful because of, uh, um,

hands-on the kids get to do with bugs and or in our
case it was bugs.

But um, we’d talk about each individual thing
talk

in the early part it was about the seeds and the um,
bugs we found and the worms and the dry leaves,
and we’d talk about all the processes (interruption).
talk

Let’s see. And then the strengths are the hands-on.

When we got the bugs actually and we, um, got to hold them.
hold

And they got to pretend they were that bug.
pretend

And they uh, then wrote things that they saw about the
bug or or I wrote what they saw about the bug.
wrote about

And then when they had questions we would do an
experiment about, like for instance, do crickets jump? experiment
We got them out on the floor and we would watch them and

do they jump or do they fly ‘cause they do have wings. watch (observe)

And, and uh, and those are little experiments we were able
to do in the classroom. experiments

So I think it was the hands-on just them being able to
touch the bugs. Some didn’t like it, most of them did. hands-on

I think that was great. great

I loved it. loved it

Grouping of Codes

hands-on (3) talk (2) pretend to be
hold wrote about
experiment (2)
great-loved watch/observe
Emergent Theme Statement

She thought the hands-on nature of the curriculum was its greatest strength. They got to hold the animals, talk about them, pretend to be them, write about them, watch and observe them, and conduct experiments about them. She thought it was great, and she loved it.
Constant Comparative Analysis Mrs. Kennedy Post Interview: Curriculum Weaknesses

Chunks

Um. Gosh, I didn’t, I don’t really see a weakness

because I love the whole program so much I want

to continue it.

Um. I’m trying to think if there is something like.

You know I I would, the only thing I would

probably do differently is go straight to the focused

piece. I like that so much.

Because it really taught them how to think better rather

than me feeding it to them. And I think for a young

scientist that’s probably the good way to start.

So that’s maybe I’d shorten the first piece and go straight

to the focused.

Codes

love

go to Focused

taught to think

shorten first
Grouping of Codes

love go to Focused taught to think
shorten first

Emergent Theme Statement

She loved the curriculum because it taught the students to think. She would probably shorten the Open Exploration and move to the Focused Exploration sooner.
APPENDIX Q

CONSTANT COMPARATIVE ANALYSIS MRS. KENNEDY POST INTERVIEW:
STUDENT RESPONSE
Constant Comparative Analysis Mrs. Kennedy Post Interview: Student Response

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<td>I’d say the majority loved them.</td>
<td>most loved</td>
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<tr>
<td>They loved the hands-on, they loved looking, and figuring it out for themselves.</td>
<td>loved</td>
</tr>
<tr>
<td>They’re not just being told what to do, they’re figuring it out.</td>
<td>figuring it out</td>
</tr>
<tr>
<td>And by now, they all know all about an insect. They all know all the parts of an insect and how to look for an insect and uh, that’s, that’s huge for little 4-year-olds. It is.</td>
<td>know insects</td>
</tr>
</tbody>
</table>

Grouping of Codes

- most loved (2)
- figuring it out
- know insects
Most of the students loved the lessons. They loved figuring things out themselves, and now they know a lot about insects.
APPENDIX R

CONSTANT COMPARATIVE ANALYSIS MRS. BENEDICT PRE INTERVIEW:
SCIENCE INSTRUCTION

Constant Comparative Analysis Mrs. Benedict Pre Interview: Science Instruction
Um, mainly as a center, science center
And we try to do it based on the theme that
we have so, um, for instance, if we did a fall theme
We usually do a theme a week, so fall theme
we try to bring in things that pertain to fall
Um, I’m trying to think if color, when we’re doing
colors, we do color mixing um,
sometimes we’ll do a baking thing if we’re doing,
um, just trying to think, um, you know
gingerbread men or bread,
or um when we do the, uh, dinosaurs we make volcanoes
We build the little baking soda and vinegar and do
the little experiment with that
but um, it’s usually just either that or memory games
Like right now we have some since we’re doing leaves,
different kinds of leaves, and just a
matching memory-type game with that
So it, kind of, we have shells, and we have, um,
you know, a scale so we’ll when we’re doing ocean
But we pull those things out from time to time, anyway,
not just when we have the theme,
we just, what we have in our science center

we’re just pulling out from time to time as well.  science center

So it doesn’t always just go with the theme  not always theme

To science. Like I say, pretty much just the theme  theme

Every now and then we would do a group experiment  experiment

Or a group project,  project

but pretty much, our center time, we have a

science table, and it’s devoted to, we try to

set up science things at that,  science center

so um, our center time is like 30 minutes to um the  center

first center time which is more of a free choice center,

and then, um, about 45 minutes, um, for our theme-based centers,  theme-based center

so it’s about 45 minutes of theme-based center time.  45 minutes

Grouping of Codes

science center (5)  colors

theme (3)/but not always  baking

volcanoes

experiments (2)/project  ocean

games (2)  45 minutes

pull out

245
Emergent Theme Statement

Science is often taught at a science center connected to a classroom theme. The teacher may pull out games or experiments on such topics as colors, baking, volcanoes, and oceans for around 45 minutes per week.
APPENDIX S

CONSTANT COMPARATIVE AND DOMAIN ANALYSES: MRS. BENEDICT PRE INTERVIEW: INQUIRY SCIENCE

Constant Comparative Analysis: Mrs. Benedict Pre Interview: Inquiry Science
<table>
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<td>Um, I would think, I’m not, you know, I would just think</td>
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<tr>
<td>it’s where you let the children or try try to help</td>
<td></td>
</tr>
<tr>
<td>you know question,</td>
<td>children question</td>
</tr>
<tr>
<td>but let them think about things and ask questions about it</td>
<td>think/question</td>
</tr>
<tr>
<td>and maybe a teacher would guide them or try to bring out</td>
<td></td>
</tr>
<tr>
<td>questions just to make them think</td>
<td>teacher guide</td>
</tr>
<tr>
<td>But um, I just think it’s more exploring and</td>
<td>exploring</td>
</tr>
<tr>
<td>inquiring and questioning and, and talking about how</td>
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</tr>
<tr>
<td>things work,</td>
<td>question</td>
</tr>
<tr>
<td>and then maybe looking it up in a book or on um, the</td>
<td></td>
</tr>
<tr>
<td>computer if, you know, and then google it or whatever</td>
<td>look it up</td>
</tr>
<tr>
<td>That’s a lot of what we do as far as things that we can’t answer</td>
<td>can’t answer</td>
</tr>
<tr>
<td>Google it and see, and we can show pictures and that</td>
<td></td>
</tr>
<tr>
<td>kind of thing</td>
<td>look it up</td>
</tr>
<tr>
<td>That’s the nice thing about the.. (interruption)</td>
<td></td>
</tr>
<tr>
<td>(Oh, my phone. It’s not doing anything, it just. I think</td>
<td></td>
</tr>
<tr>
<td>I just hit this. I don’t know why I even have it in my pocket.)</td>
<td></td>
</tr>
<tr>
<td>Um, yeah, so that’s pretty much, you know, as far as um,</td>
<td></td>
</tr>
<tr>
<td>inquiry, I think, I think we do a lot of that</td>
<td></td>
</tr>
<tr>
<td>already</td>
<td>do a lot</td>
</tr>
<tr>
<td>I think. You know, because we just talk about why are</td>
<td></td>
</tr>
<tr>
<td>the leaves turning</td>
<td>talk</td>
</tr>
</tbody>
</table>
What causes, you know, we talk about the seasons,
and what you know what’s, um, you know
what are some of the signs of fall,
and then they can, you know, question or, you know,
see what they know about it, answer and kind of do
some dialogue with it.

Does that make sense? And then you’ll have to tell me
about the inquiry thing
tell me
What else, ‘cause I think that I mean, a lot of that’s in
the curriculum, right, that we’re going be using
I’m excited. Yeah, definitely.

Grouping of Codes

children question (4) teacher guide
think can’t answer
explore look it up (2)
talk (2) do a lot

Emergent Theme Statement
In inquiry, the teacher guides the children to question, think, explore, and talk about
topics like the seasons. If the teacher can’t answer a question, she helps the students look
it up. This teacher does a lot of that, but is excited about having the researcher tell her
more about inquiry, which she thinks is in the curriculum.
Domain Analysis Mrs. Benedict Pre Interview: Inquiry Science

Semantic Relationship: Strict Inclusion

<table>
<thead>
<tr>
<th>Included Terms</th>
<th>Semantic Relationship</th>
<th>Cover Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children questioning</td>
<td>is a kind of</td>
<td>inquiry science</td>
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</tr>
<tr>
<td>Exploring</td>
<td>is a kind of</td>
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</tr>
<tr>
<td>Looking up information</td>
<td>is a kind of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Talking</td>
<td>is a kind of</td>
<td>inquiry science</td>
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Semantic Relationship: Spatial

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<td>inquiry science</td>
</tr>
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<tr>
<td>Exploring</td>
<td>is a part of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Looking up information</td>
<td>is a part of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Not always knowing the answers</td>
<td>is a part of</td>
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</tr>
<tr>
<td>Talking</td>
<td>is a part of</td>
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**Semantic Relationship: Cause-Effect**

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<tr>
<td>Looking it up</td>
<td>is a result of</td>
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<tr>
<td>Excitement</td>
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**Semantic Relationship: Rationale**

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### Semantic Relationship: Location for Action

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### Semantic Relationship: Function

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### Semantic Relationship: Means-End

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<tr>
<td>Figuring out what you can’t answer</td>
<td>is a step in</td>
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**Semantic Relationship: Attribution**

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</table>
APPENDIX T

CONSTANT COMPARATIVE AND DOMAIN ANALYSES MRS. BENEDICT POST INTERVIEW: INQUIRY SCIENCE
Constant Comparative Analysis Mrs. Benedict Post Interview: Inquiry Science

Chunks

Inquiry science is? Okay, the flow chart. (laughter)

You know, from what we’ve done, I think we’ve really

you know just to watch them wonder, to ask

questions, to just observe.

I mean, that’s so much of it for them was observing.

But then they would have some questions about what um,

what was going on or what would happen,

you know, I think for me a lot of times I was trying to show

them the book maybe before they were asking questions,

and maybe I needed to slow down a little bit,

but but to have the books there, to um, because that’s one

thing with science you know, and that was one of

the questions.
Just how comfortable sometimes I’m uncomfortable just
because I’m not sure if I can answer the questions, uncomfortable with

but having books, having resources, knowing that you can
always google stuff and um, books/resources

and to make that process you know keep that circle going
with wonder what would happen if we did this, circle

what are you interested in knowing about.

Writing that down and um, talking about um, you know

just um, you know if we did this, what would happen. wondering what

Just like when we did the crickets and trying different things, trying

so, um just experimenting with it then trying it if they

have a question about something, trying

trying to figure out how we can answer that question,

how they can answer it, figure out
and then maybe also go to a book or computer or something.

Grouping of Codes

| flow chart | wonder | show book (resources) |
| circle     | questioning | slow down |
|            | observing   | uncomfortable with questions |
| interest   | trying      | figure out |

Emergent Theme Statement

The flow chart of having the students wonder, question, observe, try things, and figure them out was inquiry. Sometimes she wanted to show them the book too soon because she was uncomfortable with questions, so she said she should slow down. She would hone in on their interests and keep the circle of inquiry going.
Domain Analysis Mrs. Benedict Post Interview: Inquiry Science

Semantic Relationship: Strict Inclusion

<table>
<thead>
<tr>
<th>Included Terms</th>
<th>Semantic Relationship</th>
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</tr>
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<tbody>
<tr>
<td>Using the flow chart</td>
<td>is a kind of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Wonder</td>
<td>is a kind of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Showing the book</td>
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</tr>
<tr>
<td>Questioning</td>
<td>is a kind of</td>
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</tr>
<tr>
<td>Slowing down</td>
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</tr>
<tr>
<td>Observing</td>
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</tr>
<tr>
<td>Being uncomfortable with</td>
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</tr>
<tr>
<td>questions</td>
<td></td>
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<tr>
<td>Showing interest</td>
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</tr>
<tr>
<td>Trying things</td>
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</table>

Semantic Relationship: Spatial

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<tr>
<td>The flow chart</td>
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<tr>
<td>Wonder</td>
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</tr>
<tr>
<td>Showing the book</td>
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</tr>
<tr>
<td>Using the circle</td>
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<tr>
<td>Showing the book</td>
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</tr>
<tr>
<td>Circling back</td>
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### Semantic Relationship: Rationale

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### Semantic Relationship: Location for Action

(None for this semantic relationship.)

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<td>Being uncomfortable with questions</td>
<td>is an attribute of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Interest</td>
<td>is an attribute of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Trying things</td>
<td>is an attribute of</td>
<td>inquiry science</td>
</tr>
<tr>
<td>Figuring it out</td>
<td>is an attribute of</td>
<td>inquiry science</td>
</tr>
</tbody>
</table>
APPENDIX U

CONSTANT COMPARATIVE ANALYSIS MRS. BENEDICT PRE INTERVIEW:
CURRICULUM
Constant Comparative Analysis Mrs. Benedict Pre Interview: Curriculum

<table>
<thead>
<tr>
<th>Chunks</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well, it’s exciting because you know a lot of</td>
<td>exciting</td>
</tr>
<tr>
<td>it for us in preschool</td>
<td></td>
</tr>
<tr>
<td>We don’t have any set curriculum, um</td>
<td>no set curriculum</td>
</tr>
<tr>
<td>We have things that we’ve done in the past</td>
<td>past</td>
</tr>
<tr>
<td>and we’ve pulled things from different resources</td>
<td>resources</td>
</tr>
<tr>
<td>but you know just recently we’ve gotten into doing</td>
<td></td>
</tr>
<tr>
<td>the Alpha Friends for the literacy part of the,</td>
<td></td>
</tr>
<tr>
<td>literacy program and the Writing Without Tears and</td>
<td>literacy program</td>
</tr>
<tr>
<td>Um, so it’s been great being able to implement those</td>
<td></td>
</tr>
<tr>
<td>and that, um</td>
<td>great to implement</td>
</tr>
<tr>
<td>This is our third year, I think of doing Alpha Friends</td>
<td></td>
</tr>
<tr>
<td>and it, you know we were able to get a preschool</td>
<td></td>
</tr>
<tr>
<td>curriculum with that and as, as well as with the</td>
<td></td>
</tr>
<tr>
<td>Writing Without Tears,</td>
<td>preschool curriculum</td>
</tr>
<tr>
<td>so um, you know, it takes a little bit of work,</td>
<td>work</td>
</tr>
<tr>
<td>just reading through the the books and picking</td>
<td></td>
</tr>
<tr>
<td>and choosing you know what we can do</td>
<td>pick and choose</td>
</tr>
<tr>
<td>We don’t always have a whole lot of time</td>
<td>time</td>
</tr>
<tr>
<td>That’s the one thing, time</td>
<td>time</td>
</tr>
<tr>
<td>It’s, it’s sometimes hard to get everything in,</td>
<td></td>
</tr>
<tr>
<td>in the amount of time that we have</td>
<td>time</td>
</tr>
</tbody>
</table>
Everything we want to do
Way too much that we want to do
Yeah, um, you know, because you know it is preschool and their attention span is, you know, shorter, um, we try to just, you know, do anything that has music and movement with it
Um, as a group, so for instance, we’re doing Alpha Friends, it’s pretty much singing their little song and doing some movement with it and talking about the letter A and then as and then we try to, or B whatever,
we try to play games as they’re dismissing to centers or something, like think of something that starts with a B, so it’s all, um, you know, as much as we can get in without going, you know, losing their attention I don’t know if that’s kind of what you want
But it’s the same way with Writing Without Tears.
You know a lot of it we just, we have some of the basic tools to use, and um, a lot of it’s just putting it out and let them experiment with it, see what they can do with it, and once again we have
a CD that has music

and, um, little games to play with, they call them sticks,

but the long line and the short line, and the curved line.

Big line, and um, little curve and big curve, so yeah,

that’s kind of how we how we do it

It’s pretty much whatever we can do with the music, I think

And movement, and at least with writing and literacy

And that’s really it as far as curric.

Yeah, we don’t, as far as math and science and art,

we pretty much, um, pull out of, you know,

what we can find on websites

and what we have, um, done in the past and that kind of thing

We’re always looking for new stuff, though

I think we play with it at first so

Yeah, I mean we’ll try to uh, you know

There’s just usually great ideas and we’ll just play

with it and see what works and, if it does,

if something doesn’t work we’ll not do that the next time,

but yeah, definitely I think we kind of, um, you know,

we’ll use what’s in the package,

but we definitely play around with it and see what works best
Emergent Theme Statement

The only set curriculum this teacher uses is the preschool literacy program. She draws upon past ideas, resources, and websites, and likes to try and play with new ideas. Although it’s great and exciting to implement a curriculum, she states that it’s work because you have to pick and choose activities you want to do within time constraints. When choosing activities, she considers the kids’ attention spans, opting for activities involving music, movement, games, talking, tools, and experiments. She uses what’s in the package, but doesn’t repeat activities that don’t work.
APPENDIX V

CONSTANT COMPARATIVE ANALYSIS MRS. BENEDICT POST INTERVIEW:
CURRICULUM STRENGTHS
Constant Comparative Analysis Mrs. Benedict Post Interview: Curriculum Strengths

Chunks

Strengths of the curriculum. Well, I think the book is

awesome. I really do.

It’s very easy to follow. It’s got some great examples.

Um, on the you know in the on the side just a you

know suggestions on what to do.

But it during cen- circle time for uh, preschool, I think it

was great is that it’s very short.

It’s not, there’s not a lot of time, circle time involved.

Large circle because you know their little attentions spans,

you can’t, although they were really into it

when we did the sometimes the large circle time took a

little bit longer,

but as far as the curriculum goes, it didn’t, you know it

was just perfect.
Um, the open the outside exploration time, some of them could have stayed out longer I think at times. You know the only you know our, we just have that time constraint and that was the only thing that was a little frustrating. You know for me because I think we could have done even more with that. But the book is, you know the appendix and all the stuff in the back, the help, the letters, the you know there’s just all kinds of ways to do it, and you couldn’t use it all, but but definitely want to. In the future, I definitely want to use this again, so.
### Grouping of Codes

<table>
<thead>
<tr>
<th>book (2)</th>
<th>easy</th>
<th>circle time short (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>perfect</td>
<td>examples</td>
<td>attention spans</td>
</tr>
<tr>
<td>time constraint</td>
<td>large circle longer</td>
<td></td>
</tr>
<tr>
<td>done more</td>
<td>outside longer</td>
<td></td>
</tr>
</tbody>
</table>

want to use

### Emergent Theme Statement

The book was perfect and easy to follow with helpful examples. The circle time was short to accommodate attention spans, though students did well when it went longer. She felt the students could have stayed outside longer. She would have liked to do more and use more of it if she didn’t have time constraints.
APPENDIX W

CONSTANT COMPARATIVE ANALYSIS MRS. BENEDICT POST INTERVIEW:
STUDENT RESPONSE
Chunk Comparative Analysis Mrs. Benedict Post Interview: Student Response

Chunks

Oh, I think great.

You know, it um, as far as um when we did our large circle time.

You know and just asking questions.

They were all so eager to give their you know two cent’s worth.

Some of them were right on, some of them, you know,

were a little confused.

Not confused, but they wanted to say, they just wanted to say something.

It might not have been quite the answer we were looking for,

but that’s okay with preschool. It’s great.

You know, just want to make sure that they felt good about

Codes

great

large circle time

questioning

eager

some on, some confused

wanted to share

preschool-great
raising their hand. felt good

Um, so um, you know, the kids um, really got into it,

especially, like I said, when we were outside, into it-outside

it was just fun to see them going bonkers over going bonkers

everything that they you know, you know just

the tiniest things, things that I wouldn’t even notice. find

That they could find.

I was gonna say, yeah, and the same with especially

when we brought the little animals into the classroom. animals

And the plants, too, when they were watering the plants, and. plants

You know, some of the children would stay there the whole time, which is unusual, because usually especially at science you know we try to put out things that you know maybe go with our curriculum, stay-unusual

our theme for the week or whatever, the theme that we’re spending that much time in science, theme
and to be so eager to run over there and see what’s out  

eager

and to draw the pictures and to look through the magnifying  

glasses and all that was really fun to see.  

draw

Grouping of Codes

<table>
<thead>
<tr>
<th>great</th>
<th>large circle time</th>
<th>questioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>going bonkers</td>
<td>theme</td>
<td>want to share</td>
</tr>
<tr>
<td>eager</td>
<td>some on, some confused</td>
<td>draw</td>
</tr>
<tr>
<td>preschool-great</td>
<td></td>
<td>into it-outside</td>
</tr>
<tr>
<td>felt good</td>
<td>find</td>
<td>stay-unusual</td>
</tr>
<tr>
<td></td>
<td>animals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>plants</td>
<td></td>
</tr>
</tbody>
</table>

Emergent Theme Statement

The students were eager and went bonkers. It was great for them, as they engaged in questions, sharing, and drawing. They found plants and animals. Some were on and some were confused, but they felt good about sharing. They were into it outside and stayed at the indoor center a long time, which was unusual. They had a great response to the curriculum, including large circle time.
REFERENCES


Conezio, K., & French, L. (2002). Science in the preschool classroom: Capitalizing on children's fascination with the everyday world to foster


http://www.whitehouse.gov/issues/education


