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South Mississippi Public Elementary School Teachers' Implementation of and Attitudes Toward Inquiry-Based Science

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SOUTH MISSISSIPPI PUBLIC ELEMENTARY SCHOOL TEACHERS' IMPLEMENTATION OF AND ATTITUDES TOWARD INQUIRY-BASED SCIENCE

by

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Abstract of a Dissertation
Submitted to the Graduate Studies Office
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

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ABSTRACT

SOUTH MISSISSIPPI PUBLIC ELEMENTARY SCHOOL TEACHERS' IMPLEMENTATION OF AND ATTITUDES TOWARD INQUIRY-BASED SCIENCE

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The present study was designed to examine the relationship between the dependent variables of K-5 elementary teachers' attitudes toward inquiry-based science, implementation of National Science Education Standards concerning inquiry-based science, and the number of inquiry-based lessons taught with the predictor variables of gender, school district teaching, ethnic group, educational level, experience, grade level teaching, and number of science courses taken. Four hundred thirty teachers of grades K through 5 from seven school districts in south Mississippi were surveyed using the Revised Science Attitude Scale (Bitner, 1994), Inquiry Beliefs and Practices survey (Jeanpierre, 2006), and a demographic questionnaire. A total of 814 teachers were invited to participate in the study. Multiple linear regression techniques were used to test the hypotheses of this study at a .05 level. Results indicate that number of courses taken is a predictor for all subscales of attitude toward inquiry-based science. Grade level teaching was a significant predictor for two subscales of attitude and gender along with school district were predictors for one subscale for attitude. Results also indicate that school district, ethnic group, and grade level teaching are significant predictors of the complex skills subscale for implementation of inquiry-based lessons. The predictors of gender, school district, and number of courses taken were found to be significant concerning the number of inquiry-based lessons taught. Positive correlations were found between the four subscales for attitude, the two subscales for inquiry beliefs and practices, and the number of inquiry-based lessons taught. Conclusions, implications, and recommendations for future research are included.

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CHAPTER I

INTRODUCTION

Since the 19th century, the United States has cycled through many rotations concerning the most appropriate direction for science education. Educators have debated the merits of a strict, mathematical-based curriculum, which caters to a few, to a "science for all" belief to produce a scientifically literate populace (DeBoer, 1991). Convincing arguments have been proposed for both sides over the years, many times being triggered by a significant event, such as the launching of Sputnik or something as simple as an election of a new president, leading to such legislation as No Child Left Behind. The guidelines for science educators today are found in the National Science Education Standards (NSES). The pendulum of science education has once again swung to the scientific literacy for all peak, and the current standards are designed to enable the nation to achieve this goal (National Research Council [NRC], 1996).

The expectations of NSES will be discussed in more detail in Chapter II, but, as stated by the authors of NSES, many students in America today do not have the opportunity to meet the science goals because their school district is not able to provide the opportunity (NRC, 1996). Is this the case in South Mississippi? As a state consistently ranking at or near the bottom in most educational categories, what is the attitude of teachers toward teaching science, have they implemented NSES, and do they use inquiry-based lessons, a focal point of NSES? If teachers have negative attitudes toward teaching science, have not implemented the guidelines of NSES, and are not using inquiry-based lessons in their classrooms, students certainly have no hope of becoming scientifically literate Mississippians. If educators want to implement NSES, they must understand their current status before they can design a path to achieve success, thus, this study.

The position of the National Science Teachers Association (NSTA) is that inquiry science must be a basic in the daily curriculum of every elementary school student at all grade levels. NSTA further states that elementary school students value science best when inquiry skills and positive attitudes are modeled by the teacher (NSTA Official Positions, 2002). Meeting the expectations of NSTA will require well trained, knowledgeable, and confident elementary school teachers with positive attitudes toward science teaching. The perception is that elementary science teachers, in general, possess few of these traits. Perception is not always reality. This study will examine the current state of elementary science teachers in selected south Mississippi school districts.

Attitude can be defined as the state of mind or feeling with regard to some matter. All of their lives individuals are told to have a good attitude, or a positive attitude, when faced with some task to complete. They are also scolded if they have a bad attitude or told they will not possibly succeed with such a poor attitude. The general use of the word attitude ingrains into an individual's belief system that a good attitude is required to complete any challenge that is faced. If attitude is so important in everyday lives, how it relates to an elementary science teacher's performance in the classroom should be discussed.

> The longer I live, the more I realize the impact of attitude on my life. Attitude, to me, is more important than facts. It is more important than the past, than education, than money, than circumstances, than failures, than successes, than what other people think or say or do. It is more important than appearance, giftedness or skill.

It will make or break a company, a church, a home. The remarkable thing is we have a choice every day regarding the attitude we will embrace for that day. We cannot change our past . . . we cannot change the fact that people will act in a certain way. We cannot change the inevitable. The only thing we can do is play on the string we have, and that is our attitude. . . . I am convinced that life is ten percent what happens to me and ninety percent how I react to it. And so it is with you . . . we are in charge of our attitudes. (Swindoll, 1990, n.p.)

Numerous studies have examined the relationships between teacher attitude and student performance (Talsma, 1996; Watters & Ginns, 1995; Young, 1998). Teachers who are successful in the elementary science classroom have been found to provide opportunities for their students to explore ideas and the physical world around them. In spite of the teacher's personal content knowledge concerning science, the students' enthusiasm can be molded by the teacher's attitude (Rhoton & Shane, 2006). Common sense tells of the importance of a good attitude in the elementary science classrooms, but where will these teachers come from? Education is currently experiencing a time when elementary teachers do not feel well qualified to teach science, and they are teaching less science (Horizon Research, 2002). If teachers do not feel comfortable with the content, how can they possibly have a positive attitude toward teaching science?

Many types of individuals will be involved in improving science education, but teachers are the primary connection between the NSES and the students they are intended to serve. The NSES emphasizes a new way of teaching and learning about science that reflects how science itself is done (NRC, 1996). Without knowledgeable, informed teachers who are enthusiastically implementing NSES in their elementary science classrooms, the hope of improving the status of education in Mississippi is greatly reduced. Many studies have been completed that examine elementary teacher's attitudes, content knowledge, pedagogical content knowledge, etc., but the literature is severely lacking in determining the teacher's implementation of NSES. Are teachers familiar at all with NSES? Do they consider NSES when planning their lessons? Do teachers know nothing about NSES? Their level of knowledge concerning NSES needs to be determined. This study may find that the teachers have a working knowledge of NSES or possibly that they know very little of NSES. Teachers cannot be expected to teach effectively with inquiry-based methods or to guide their students in meaningful science experiences if they are not keenly aware of the guidelines from NSES.

Inquiry-based learning is a prominent topic for the framers of NSES. According to NSES, engaging students in inquiry helps them develop

1. understanding of scientific concepts
2. an appreciation of "how we know" what we know in science
3. understanding of the nature of science
4. skills necessary to become independent inquirers about the natural world
5. the dispositions to use the skills, abilities, and attitudes associated with science

Most of the individual standards within NSES change from very general requirements for the elementary level to more detailed and specific requirements for the high school level. However, the standard for inquiry lists abilities necessary to do scientific inquiry and understanding about scientific inquiry for grades K-12 (NRC, 1996). The standard indicates the need to start early in the development of inquiry skills and for educators to reinforce and refine continually these same skills for a student's entire educational career. The overall goal of NSES, to have a scientifically literate population, will not become reality unless students develop the ability to use inquiry effectively. The development of Mississippi students' inquiry abilities will have to begin in the elementary science classroom in order for them to reach an acceptable level of competence.

If all Mississippi students are to become literate in science, teachers will have to exhibit positive attitudes toward science, be well versed in NSES, and implement inquiry-based lessons into their teaching. These requirements will have to begin in the elementary science classroom and continue through the students' secondary education. This study will provide insight into the status of educators concerning attitude, NSES, and inquiry-based lessons for the elementary classroom. With this information, educators will be better able to understand how they should proceed in order to reach their goals.

Statement of the Problem

The problem of this study is stated as follows: What is the current status of elementary science teaching in selected Mississippi school districts from the counties of Forrest, Lamar, Pearl River, Perry, and Harrison? Specifically, what is the nature of elementary school teachers' attitudes toward inquiry-based science lessons in these counties, what is the nature of their implementation of NSES in the area of elementary science, and what number of inquiry-based lessons are being taught? Is there a significant independent relationship between demographic data and the dependent variables of teacher's attitudes toward teaching elementary science, of their implementation of NSES, and their use of inquiry-based lessons related to elementary science teaching?

Research Questions

This study is an attempt to investigate the following questions:

1. What are the attitudes of elementary school teachers in selected school districts from Forrest, Lamar, Pearl River, Perry, and Harrison counties toward teaching of inquiry-based elementary science?

2. What is the level of implementation concerning NSES in the area of elementary science for elementary school teachers from selected school districts in Forrest, Lamar, Pearl River, Perry, and Harrison counties?

3. What number of inquiry-based science lessons are used in the elementary school classroom from selected school districts from Forrest, Lamar, Pearl River, Perry, and Harrison counties?

Hypotheses

This study is designed to evaluate the following null hypotheses:

H1: There is no significant relationship between the dependent variable of attitude toward the teaching of elementary school inquiry-based science as measured by The Revised Science Attitude Scale and the independent variables of gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses.

H2: There is no significant relationship between the dependent variable of implementation of NSES for elementary school teachers as measured by the Inquiry Beliefs and Practices instrument and the independent variables of gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses.

H3: There is no significant relationship between the dependent variable of number of inquiry-based science lessons in the elementary school classroom as measured by the demographic survey and the independent variables of gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses.

H4: There is no significant relationship between the attitude scores of the school district teachers as measured by The Revised Science Attitude Scale and the scores of implementation of NSES as measured by the Inquiry Beliefs and Practices.

H5: There is no significant relationship between the attitude scores of the school district teachers as measured by The Revised Science Attitude Scale and the number of inquiry-based science lessons as measured by the demographic survey.

H6: There is no significant relationship between the implementation of NSES as measured by the Inquiry Beliefs and Practices and the number of inquiry-based lessons used as measured by the demographic survey.

Definition of Terms

The following is a list of terms and their meanings with reference to this study.

Attitude scores - the scores obtained by the county teachers on The Revised Science Attitude Scale.

Demographic data - personal and professional information supplied by the school district science teachers concerning their gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses taken.

Dependent variable - the variable of attitude as measured by The Revised Science Attitude Scale, the variable of implementation of NSES as measured by the Inquiry Beliefs and Practices, or the variable of number of inquiry lessons used as measured by the demographic survey.

Educational level - the highest college or university degree earned and any additional credit hours.

Elementary school teacher - any person certified and engaged in the teaching of elementary students in a public school in any grade, kindergarten through fifth grade, from stated counties.

Independent variable - the variable of gender, school district, ethnic group, educational level, science teaching assignment, years of teaching, or the number of science courses.

Inquiry Beliefs and Practices - instrument designed to measure a teacher's implementation of inquiry-based methods within their classroom.

National Science Education Standards (NSES) - accepted standards to reach the goal of scientific literacy for everyone.

Science teaching assignment - one of the grades: kindergarten, first, second, third, fourth, or fifth.

Scientific literacy - sufficient knowledge of science to be an effective citizen in today's culture without special career interest in science.

The Revised Science Attitude Scale - instrument designed to measure an elementary school teacher's attitude toward teaching science with inquiry methods.

Delimitations

1. This study was limited to teachers of grades kindergarten through fifth grade from selected school districts in the counties of Forrest, Lamar, Pearl River, Perry, and Harrison in the state of Mississippi.

2. All variables and school personnel not mentioned in this study may be considered beyond the scope of the study.

3. This study was limited to the variables of attitude, implementation of NSES, number of inquiry lessons used, and demographics within the survey instrument.

Assumptions

This study attempts to determine the status of elementary science teaching in selected school districts from the Mississippi counties of Forrest, Lamar, Pearl River, Perry, and Harrison. It is assumed that the participants in this study provided accurate and honest remarks concerning their attitudes toward teaching elementary science, implementation of NSES, and number of inquiry lessons taught.

Justification

The literature on elementary teachers' attitudes and the importance of inquiry-based lessons is plentiful throughout the nation and world (Hubbard & Abell, 2005; Luera & Otto, 2005; Plourde, 2002; Talsma, 1996; Youker, 2002; Young, 1998). Any attempt by this researcher to add any significant improvements to the existing work is futile. However, as an educator living in south Mississippi, a state consistently ranked near the bottom in all educational studies, the status of elementary science education is an important topic to examine. Improving the science literacy for the students in Mississippi has to be a high priority if students are to compete in an increasingly technological nation and world. The ultimate goal for this researcher is to apply for a National Science Foundation grant to provide the elementary teachers in Forrest, Lamar, Pearl River, Perry, and Harrison counties with probeware and training to improve their ability to reach NSES in their classrooms. Changing a nation that is behind in science education is a lofty goal; changing a few counties in south Mississippi is a realistic goal. The results of this study should provide the first step to changing a small part of Mississippi for the better.

This present study was designed to provide the necessary data to determine the number of inquiry-based lessons being taught in the elementary science classroom, indicate the current attitudes of elementary school teachers toward inquiry-based lessons, and determine the implementation of NSES by elementary school teachers in selected school districts from the Mississippi counties of Forrest, Lamar, Pearl River, Perry, and Harrison. This study will contribute to the broad field of elementary science teachers' attitudes toward teaching science (Cobern & Loving, 2002; Talsma, 1996; Young, 1998) and to the work of Jeanpierre (2006) concerning what elementary teachers state about their inquiry practices and what inquiry practices are actually implemented in their classrooms. Current research is deficient concerning the relationship between elementary teachers' attitudes toward inquiry teaching methods and their implementation of inquiry-based teaching methods. This study should contribute to filling this gap and provide data necessary to prepare teacher training material for professional development in inquiry-based science teaching methods.

CHAPTER II

REVIEW OF THE LITERATURE

Because the primary purpose of this study is to identify elementary school teachers' attitudes toward teaching science with inquiry and their implementation of NSES, this review of literature focuses on four major topics: elementary teachers' attitudes toward teaching science with inquiry-based methods, attempts to improve elementary teachers' attitudes toward teaching science with inquiry-based methods, barriers to implementing inquiry as a method of teaching elementary science, and an overview of NSES. Each section will give an overview of the current research, and a review of the history of inquiry learning will be presented.

Teachers' Attitudes Toward Teaching Science with Inquiry-based Methods

The relationship between teacher attitude and student performance has been investigated by many researchers (Talsma, 1996; Youker, 2002; Young, 1998). Young (1998) concluded that positive attitudes must be formed during elementary through secondary school, and this result is only achieved if the teachers themselves have positive attitudes toward science curriculum. Young also found that elementary pre-service teachers do not believe science to be of value to them as it pertains to their everyday lives. If teachers do not recognize the effects of science on their everyday lives, perhaps they will have difficulty engaging their elementary students in real-life, inquiry-based activities. Talsma (1996) examined the attitudes of 56 pre-service elementary teachers by reviewing science-autobiographical essays. She listed five themes that contribute to future teachers' attitudes toward science:

1. The domination of text-based science education in the schooling of pre-service teachers and its association with negative experiences of science

2. The strong impression that hands-on experiences had in the recall of science experiences across all levels of schooling and its generally positive association

3. Recalled interactions with other individuals (teachers, parents, peers, etc.) in modeling attitudes and providing opportunities to experience science, either positive or negative

4. The important role of non-form experiences in science in helping to frame positive attitudes toward science

5. The effect that the reflection on their prior experiences had on creating positive visions of their future classrooms

Talsma found that pre-service teachers had vague memories of text-based science instruction; but these same teachers were able to provide more detailed descriptions about their hands-on activity experiences as far back as their elementary school days, and they viewed these experiences as favorable.

Self-efficacy is a determinant of behavior dependent on the particular teaching situation. For the purposes of this study, the situation is teaching elementary science. Watters and Ginns (1995) subscribe to Bandura's argument that performance is the major predictor of self-efficacy which implies that students who experience successful learning will have positive self-efficacy. In their interviews of pre-service elementary science teachers, Watters and Ginns developed a series of assertions from the responses of the students:

1. Experiences in school are related to low or high self-efficacy.

2. Science experiences for positive self-efficacy changes should be fun.

3. Opportunity for discussion and interaction promoted the maintenance or improvement of self-efficacy and provided an environment where risk taking was encouraged.

4. Students are driven by internal and external motivation.

5. Science teaching outcome expectancy is enhanced through experiences with children.

All five of these assertions are somehow related to the connections between teachers' past experiences in science and their beliefs about science as adults, or the use of hands-on activities providing improved impressions of science and science teaching. The three studies discussed above indicate the importance of quality elementary science education in the development of positive attitudes toward science, not only for teachers, but for all students. Young (1998) states:

> Those who are involved in primary teaching must not only be knowledgeable with respect to science and its associated pedagogy but they should also convey a positive attitude towards the subject. The pupils may then be more motivated to develop their scientific literacy during their secondary phase of education and beyond. (p. 96)

This quotation summarizes the importance of teachers' attitudes toward the teaching of science in the elementary classroom. If teachers' attitudes are so important to the success of the students they are responsible for, then what those attitudes are and ways to change the attitudes that are not conducive to student learning must be found (Young, 1998).

There appears to be a vicious loop in place possibly contributing to the shortcomings in elementary science education. According to Youker (2002), pre-service teachers reported positive attitudes toward science when they experienced hands-on, inquiry-based methods of instruction by quality teachers in elementary and secondary school, and these same teachers reported negative attitudes toward science when they experienced textbook-based, content-driven curriculum during their elementary science, formative years. The educational system that provides pre-service teachers and future in-service teachers is a contributing factor in determining the attitude of the future teachers within the very system. The ones responsible for improving the situation are products of a flawed system, and they bring the attitudes developed in elementary and secondary school with them to the teacher training programs, only to return to classrooms all over the United States to continue the cycle.

Another consideration related to attitude is the belief of elementary teachers about their ability to teach science and their self-efficacy toward teaching science. Teachers with high self-efficacy have been found to do more inquiry-based lessons and take risks in the classroom, while teachers with low self-efficacy rely on teacher-led lessons and use the textbook to guide instruction (Plourde, 2002). The task now becomes figuring out how to increase the self-efficacy of future teachers. Plourde studied a group of pre-service teachers before and after their student teaching experience to measure their self-efficacy changes. Their self-efficacy declined after the student teaching experience. Three reasons were proposed for this unexpected decline. After observing mentor teachers, dealing with limited curriculum time for science, and having a lack of equipment and materials needed for inquiry activities, the soon-to-be elementary science teachers had a diminished view of their ability to teach science (Plourde, 2002). A similar study observed and interviewed three first-year elementary school teachers who had completed science methods courses together at the same university. The teachers chosen had low, middle, and high self-efficacy scores. All three of these teachers completed inquiry-based activities during their first year, and they all scored high on the self-efficacy instrument at the end of the year. These teachers dealt with the same issues as the teachers in the previous study but overcame the negative effects. The researchers assert that the teachers received positive feedback from their students during the inquiry activities which encouraged them to continue with research-based instructional methods (Ginns & Watters, 1998).

Not all researchers are convinced that measurements of attitude are a true reflection of the actual beliefs of those being studied. Young (1998) measured the attitudes of student teachers from different disciplines with science and non-science backgrounds and found that most had positive attitudes toward science with only English, environmental studies, and, surprisingly, technology majors showing a negative view. Of the students with a negative view of science, most expressed a memory of elementary or secondary school science as the primary reasons for their negative feeling. The importance of a positive attitude by elementary and secondary school science teachers cannot be overstated. Young expresses concerns about the standard instruments used to measure attitudes as to their reliability and validity, and he even acknowledges the difficulties with the ATSI instrument used in his study. Young's (1998) work hints that not all researchers are necessarily on the negative attitude of elementary science teachers' bandwagon, at least not with the stock definition of attitude. Is there a difference between a negative attitude toward science and someone being anti-science? Could a teacher be in favor of science and still have a negative attitude toward the subject? Using the *Thinking about Science*, survey, Cobern and Loving (2002) have attempted to shed some light on these questions. Their findings indicate that the feelings of elementary teachers are not anti-science. They are basically in line with the feelings of the general public and many scientists. However, the teachers, along with the public, feel that science, as currently taught, is not necessarily relevant to their lives. The authors of this study make an interesting point, "We should not think someone is anti-science just because he or she does not think about science exactly as we do" (p. 1029).

Ample research exists to indicate that a negative attitude toward science can adversely affect teacher performance in the classroom and in turn diminish the attitude of elementary students throughout their lives (Talsma, 1996; Watters & Ginns, 1995; Young, 1998). This is seemingly a continuous cycle doomed to repeat itself unless positive changes are implemented. As cited, research also exists stating that the attitudes defined by some as negative are just a reflection of the feelings of society and are not necessarily negative (Cobern & Loving, 2002). Whether or not the attitudes are defined as negative is unimportant. Finding solutions to correct the deficiencies is the major emphasis needed to concentrate efforts.

Attempts to Improve Elementary School Teachers' Attitudes Toward Inquiry-based Science

The National Science Education Standards, to be discussed later in the literature review, suggest that K-12 students should develop "abilities necessary to do scientific inquiry" and "understandings of scientific inquiry" (NRC, 1996, p. 121). NSES does not, however, give specific guidelines on how to conduct inquiry in individual classrooms.

NSES allow teachers to develop their own methods as they pertain to their unique teaching situation (Keys & Bryan, 2001). The efforts being made to implement NSES concerning inquiry learning and the potential barriers to meeting NSES should be discussed.

If 10 experts in the field of science education were asked to define inquiry learning, you would get 10 different answers (Rhoton & Bowers, 2001). Inquiry learning basically falls into two categories, full or open inquiry and guided inquiry. Full inquiry, as described by NSES for K-4 students, involves asking a simple question, completing an investigation, answering the question, and presenting the results to others (NRC, 1996). In full inquiry, there is no authority providing answers, no voice providing hints as to the right direction, and no person to confirm results. Students experience not only the satisfaction of investigating a question, but also learn to deal with the frustration of making mistakes (Layman, Ochoa, & Heikkinen, 1996). In guided inquiry, the teacher takes on the role of setting the parameters of the investigation. The teacher may provide a question for the students to investigate or control the variables by only providing select materials for the students to design their experiments (Rhoton & Shane, 2006). The teacher becomes a facilitator or resource for the students (Layman et al., 1996). A facilitator is a person who provides guidance through difficulties or assists students. The teacher as a facilitator is not someone who stands by to observe students, but is someone who is knowledgeable about scientific content and pedagogy. This teacher must create an environment where students are able to explore questions and be inquisitive (NSF, 1997). Attempts at open inquiry by novice teachers and more experienced teachers have proven to be difficult to near impossible with many of these teachers reverting back to text-driven lessons after a bad experience (Rhoton & Bowers, 2001). Teachers have found guided inquiry to be an effective method for their students, understanding that implementing guided inquiry lessons with their students is a slow process that will possibly lead to open inquiry as the students gain more confidence and skills (Layman et al., 1996, p. 34).

Inquiry is much more than a series of steps to be followed; it is a way of thinking. The work of radical constructivists would seem to fit the inquiry requirements, but true constructivism of Von Glasersfeld leaves out the social and cultural sides of education (Keys & Bryan, 2001). Setting aside the complexities of describing inquiry learning, the task of implementing real changes will face many obstacles. Teacher attitude toward science teaching certainly plays a role, as documented; but, according to Charles Anderson, co-editor of the *Journal of Research in Science Teaching*, there is more that can be known than what is known (Anderson, 2001). Ways to deal with the ideas and practices of students, teachers, researchers, scientists, and parents will have to be found. Along with these various groups of stakeholders comes a complex set of cultures, bias, opinions, and languages that must be considered when implementing inquiry-based science lessons as suggested by NSES (Keys & Bryan, 2001).

Keys and Bryan (2001) recommend essential research that needs to be conducted in order to have any real reform. This research cannot be carried out in universities, isolated from the elementary classroom, but must have teachers intricately involved in the process. Participating as subjects in a study is not considered involvement. The teachers must have a voice in the design of inquiry-based lessons taking into account the diverse environment in which they work. This work is necessary to inform the science education community, teachers, administrators, teacher educators, and the public what inquiry-based science lessons will be used and what student outcomes are expected. The teachers must accept and desire change in their classrooms for reform to take place. Directives from Washington, DC, or state assessment requirements have not been an effective means to force reform (Anderson & Helms, 2001).

Research indicates that taking traditionally taught science courses, while increasing content knowledge, does not increase students' self-efficacy or ability to successfully complete inquiry-based lessons (Bleicher & Lindgren, 2005; Smith & Anderson, 1999; Tosun, 2000). However, when pre-service elementary science teachers complete inquiry-based courses from a wide range of disciplines such as biology, physics, geosciences, or additional inquiry-based methods courses, an increase in attitude toward inquiry-based methods and increase in ability to write inquiry lessons have been found. Success in improving attitudes and self-efficacy concerning inquiry-based lessons comes from teaching the teachers with these same methods (Barnett, Kafka, Pfitzner-Gatling, & Szymanski, 2004; Bleicher & Lindgren, 2005; Hubbard & Abell, 2005; Luera, Moyer, & Everett, 2005; Luera & Otto, 2005; Weld & Funk, 2005).

In-service teachers have two options available to them when desiring to improve their inquiry skills—professional development and summer workshops. Professional development programs have shown promise in positively impacting teachers' attitudes toward inquiry-based lessons and in improving confidence in completing inquiry lessons with their students (Banilower, Heck, & Weiss, 2007; Kimble, Yager, & Yager, 2006; Klein, 2005). All of these programs, similar to pre-service courses discussed, used some component of inquiry-based methods to train the teachers.

Summer workshops are another opportunity for elementary science teachers to update and improve their knowledge of various topics; however, the retention level in attitude gained after completing a workshop is in question (Akerson, Morrison, & McDuffie, 2006; Chun & Oliver, 2000). Workshops, using inquiry-based methods have shown increase in self-efficacy, attitude, and ability to implement inquiry lessons in the elementary classroom (Akerson, Hanson, & Cullen, 2007; Bohning & Hale, 1998; Chun & Oliver, 2000; Jones, 1997).

The common thread in all successful training methods for elementary science teachers is the use of inquiry-based methods to conduct the course. When instructors allow the teachers to experience inquiry methods, rather than lecture to them about inquiry, advances are made.

Barriers to Implementing Inquiry as a Method of Teaching Elementary Science

The National Research Council (NRC) released the National Science Education Standards (NSES) in 1996. The standards outline expectations in all areas of science. In regard to inquiry standards, the NRC states:

> Students in all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about the relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments. (NRC, 1996, p. 105)

Twelve years have passed since NSES were written and educators are faced with many challenges in implementing the recommendations. If elementary science teachers are expected to implement NSES in their classrooms throughout the country, universities must prepare them. In a study of six universities' science teacher education programs and a nationwide survey of teacher education programs, universal inclusion of science teaching standards did not exist (Smith & Gess-Newsome, 2004). In the elementary classroom, what teachers report about their practices concerning inquiry and what they actually practice is not necessarily a representation of inquiry as defined by NSES. Teachers indicate that they are carrying out inquiry-type processes, but their responses to questions about the activities going on in their classrooms do not reflect inquiry as suggested by NSES (Jeanpierre, 2006).

Elementary teachers have a reputation of weak content knowledge and weak pedagogical content knowledge with regard to science, and these factors certainly play a role. However, an increase in content knowledge does not necessarily equate into improved inquiry methods. Tosun (2000) found no significant effect on science teacher self-efficacy when evaluating a group of teachers with high science content hours compared to a group with low science content hours. Being successful in traditional science content courses such as geology, chemistry, and physics does not always lead to success with inquiry methods. Students with high marks in these types of courses when compared to students with poor marks in the same courses showed no significant differences in self-efficacy when enrolled in the same inquiry-based methods course (Smith & Anderson, 1999).

If content knowledge is lacking, common sense dictates an increase in a teacher's science content knowledge would make them better prepared to teach science (Appleton & Kindt, 1999; Davis, 2003; Gee, Boberg, & Gabel, 1996; Gee & Gabel, 1996; Parker & Heywood, 2000). Implementing national standards for inquiry requires more than increased content knowledge (Smith & Anderson, 1999). Teachers are being asked to teach the subject of science with little content knowledge, and they are being asked to teach it with methods that go against their traditional culture. Teachers have attended K-12 schools and university programs being taught with traditional methods (Smith & Gess-Newsome, 2004). These teachers have fear of failure, must make an A, dislike censure of their work, and have been taught with methods completely void of the nature of science for all of their academic lives. When asked to abandon all that they know and trust to participate in and implement the inquiry standards, they resist what is contrary to their comfort zone (Spector & Strong, 2001).

The challenges discussed above are primarily personal in nature. There are additional challenges inherent to the school systems. Major impeding factors for elementary science teachers and their ability to teach with inquiry methods are lack of time, financial resources, and curriculum standards mandated by state and district school systems (Eiriksson, 1997; Lee, 2003; Newman, Abell, Hubbard, McDonald, Otaala, & Martini, 2004). Teachers have limited time to teach science. Much of their day is spent teaching reading, writing, and arithmetic. Inquiry lessons can be more time consuming to conduct, and many times they are not included in lesson plans. The materials required for activities cut into already tight budgets, and state mandated testing places pressure on the teacher to prepare the students for a test versus meeting NSES. Teachers also receive pressure from peers to conform to the methods already in place and to follow the prevalent teaching methodologies (Eiriksson, 1997).

The NSES also suggest the use of technology within the science classroom. Technology should be an asset to a teacher implementing inquiry-based lesson, but a study of sixth grade students found that when technology, in the form of computers, was introduced into the lesson, the amount of observable inquiry processes decreased. The teacher in this study was described as a technology enthusiast with strong technology skills, but the students stopped communicating with each other when the computers were turned on (Waight & Abd-El-Dhalick, 2007). As more technology is placed in elementary classrooms, teachers will have to be creative to designing inquiry lessons to meet NSES.

Teacher training will also have to be carefully planned and long term. Teachers' retention of inquiry-based methods is also a concern. Teachers completing a course on the nature of science were found to have an increase in views of inquiry-based methods, but when tested 5 months later, their views had reverted back to their old misconceptions. They did not internalize the new information (Akerson et al., 2006). With all of the obstacles facing elementary education and the teachers teaching science, it is little wonder that educators are not further along in implementing NSES.

History of Inquiry-based Methods

Each year as this educator teaches first-year chemistry students about the history of atomic theory, he is always intrigued by the fact that Democritus and the atomists had the idea of an atom being the smallest piece of matter in 400 B.C. The atomists were on the correct path, but ideas from others took center stage and it would be 2,000 years before scientific thought would return to the atom. Inquiry teaching methods follow a similar path. Socrates (469/399 B.C.) taught his students orally. He used a series of questions to lead individuals to logical conclusions through the inductive approach. His goal was to reach a true universal definition by questioning what was assumed to be true. With skillful questioning, a student's unconscious ignorance is brought to conscious ignorance of a topic; when the student realizes his or her misconceptions, he or she is ready to begin learning (World Civilizations, 1996). Plato (427/347 B.C.) was the best known pupil of Socrates. After the death of Socrates, Plato continued his teaching method by discussing the dialogues between Socrates and his students, but over the years, Plato's methods evolved to more teaching from the discussions versus the questioning methods of his mentor. This instructional model became known as the dialectic method and used critical inquiry to develop high reasoning skills.

Aristotle (384/322 B.C.) believed, unlike his predecessors, that a problem should be thought through based on evidence. Aristotle would seek to find what others had written about a subject, examine the general consensus of opinion on the subject, perform a systematic study of everything pertaining to the subject, and then reach a conclusion. This method is the basis of inductive reasoning and provides the foundation of today's scientific method (World Civilizations, 1996).

Francis Bacon (1561/1626) provided an alternative approach for the scientific method. He believed that the classic teaching of his day and the methods of Aristotle were in the wrong order. He proposed collecting evidence first, through observation and experiment, and then forming hypotheses to explain the findings, based on the evidence. He felt that forming the hypothesis first, without any support, led to a structure of knowledge that would collapse when evidence was discovered to contradict the original idea. His methods did establish a new way of conducting inquiry; however, they also could lead to seemingly endless data collection and experiment without any imaginative thinking taking place (The Internet Encyclopedia of Philosophy, 2006).

Johann Amos Comenius (1592/1670) was motivated by his desire to alleviate the suffering of the people in his day. He believed that students should be taught to find knowledge through experiences and that teaching should proceed from simple to complex. Teachers should develop students who would continue to learn throughout their lives. He is known as "The Father of Modern Education" for his belief that all learning began with the senses, and learners gained knowledge on their own. One of the principles from the work of Comenius is that nature makes no leaps but proceeds step by step. His thought that instruction should be given in logical steps, just as in nature, contributed to the logical structure of the inquiry method (Kaufman, 1971).

Johann Fredrick Herbart (1776/1841) began the work of placing education and teaching together. He considered teaching to be the central activity of education and very powerful:

> The individual who acquires a "versatile range of interests" through teaching will "be capable" of doing with inner ease everything that he "wishes" to do after "mature reflection." He will always keep his ethical ideal clearly in mind, and in his progress toward the attainment of that ideal, he will be able to rely on his own pleasure in further learning and on the dependable "strength of his own character" (p. 3)

These thoughts by Herbart are the core of inquiry-based methods of today. He believed that student learning must begin with their interests in a particular topic and be followed by careful guidance of a facilitator/teacher to enhance the students' understanding of the topic. Education should teach students how to learn in and explore the world around them for a lifetime (International Bureau of Education, 2000).

Friedrich Wilhelm Froebel (1782/1852), the originator of the kindergarten center, believed in learning through activity.

> The purpose of education is to encourage and guide man as a conscious, thinking and perceiving being in such a way that he become a pure and perfect representation of that divine inner law through his own personal choice; education must show him the ways and meanings of attaining that goal. (Froebel, 1826, p. 2)

Much like Herbart, Froebel thought education should serve as a guide in self-understanding with teachers serving as facilitators. These attributes are a staple in inquiry-based learning today (Encyclopedia of Informal Education, 1995).

John Dewey (1859/1952) could be credited with articulating current ideas on inquiry. He believed that for students to truly learn, they must have an interest in the topic. He was against the classroom lecture, believing it only provided information; for the student to truly learn, he or she must act upon the information through some prior experience (North Carolina State University, 2007). Dewey's words describe his feelings on the role of the educator and the way students learn:

> Save as the efforts of the educator connect with some activity which the child is carrying on of his own initiative independent of the educator, education becomes reduced to a pressure from without. It may, indeed, give certain external results, but cannot truly be called educative. (1897, p. 77)

Dewey considered science to be a way of thinking, not an accumulation of information (Bybee, 2000). His beliefs, which he would apply to all educational endeavors, describe what inquiry learning should be.

Much historical background has been presented framing the development of inquiry-based learning and teaching, but what has occurred in the past 25 years to bring the call for inquiry-based science into the elementary classroom? In August 1981, then-Secretary of Education T. H. Bell created the National Commission on Excellence in Education. He directed this commission to report on the quality of the United States educational system within 18 months. The report was entitled *A Nation at Risk*, which sounded an alarm of declining performance by America's schools. The report offered recommendations in all areas of education. Concerning the teaching of science, the commission stated that science students should be provided with an introduction to the methods of scientific inquiry and reasoning (*A Nation at Risk*, 1983).

In 1985, the American Association for the Advancement of Science (AAAS) began its work on Project 2061. From this project, *Science for All Americans* was published in 1989. This publication defined scientific literacy and stated in chapter one concerning the nature of science and inquiry that everyone can think scientifically about interests of everyday life (AAAS, 1989). A follow-up document, *Benchmarks for Science Literacy*, was completed by AAAS in 1993. This document provided a blueprint of how to achieve the science literacy called for in *Science for All Americans*. *Benchmarks for Science Literacy* maps out guidelines to develop inquiry learners from grades K-12 (AAAS, 1993).

The National Research Council (NRC) published the National Science Education Standards (NSES) in 1996, presenting the role of inquiry-based science instruction (Keys & Bryan, 2001). The NSES have their foundation from *Science for All Americans* and *Benchmarks for Science Literacy* and provide criteria to judge progress toward a national vision of learning and teaching science (NRC, 1996, p. 12). The NSES are in support of inquiry as the method of teaching science and declare that "scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based of evidence derived from their work" (p. 23) and "authentic questions generated from student experiences is the central strategy for teaching of science" (p. 31). The NSES provided the goal of understanding and doing inquiry in America's classrooms, but finding a way to reach these goals is in the hands of researchers and educators.

CHAPTER III

METHODOLOGY

The purpose of this study was to measure the attitude toward inquiry-based learning, to measure implementation of inquiry-based lessons as suggested by NSES, and to determine the number of inquiry-based lessons completed by K-5 elementary teachers in five south Mississippi counties. Chapter III presents a description of the research design, participants, instrumentation, procedures, and treatment of data.

Research Design

The research questions addressed in this study are:

Question 1: What are the attitudes of elementary school teachers from selected school districts in Forrest, Lamar, Pearl River, Perry, and Harrison counties toward inquiry methods when teaching elementary science?

Question 2: What is the level of implementation concerning NSES in the area of elementary science for elementary teachers from selected school districts in Forrest, Lamar, Pearl River, Perry, and Harrison counties?

Question 3: What number of inquiry-based science lessons are used in the elementary classroom by teachers from selected school districts in Forrest, Lamar, Pearl River, Perry, and Harrison counties?

In order to answer these questions, the researcher used the following independent and dependent variables. The independent variables to be collected are gender, Mississippi school district, ethnic group, educational level, teaching experience, grade level teaching, and science courses taken by teacher. Three dependent variables were examined:

1. Number of inquiry lessons completed in the teachers' classes for the 2007-2008 school year

2. K-5 elementary school teachers' attitudes toward inquiry-based science teaching methods

3. K-5 elementary school teachers' beliefs and practices concerning implementation of inquiry teaching methods

Participants

The participants for this study consisted of in-service K-5 teachers in seven school districts from a southeastern state. Names and addresses of district superintendents were retrieved from the state's educational website. The school districts were chosen because of their diversity and close proximity to The University of Southern Mississippi. Letters (Appendix A) were e-mailed to superintendents requesting that their school districts participate in the study. In addition, a cover letter was included (Appendix B) detailing directions on how participants are to complete the survey. A copy of a demographic questionnaire, *The Revised Science Attitude Scale,* and the *Inquiry Beliefs and Practices* survey instruments (Appendix C), one for each K-5 teacher, was hand delivered to each principal's office; an envelop was provided to each principal for the surveys to be placed in and collected by the researcher. The surveys were distributed to approximately 800 teachers from the seven school districts.

Instrumentation

Two instruments were used to collect quantitative data in this study, *The Revised Science Attitude Scale* (Bitner, 1994) (Appendix C) and the *Inquiry Beliefs and Practices* (Jeanpierre, 2006) (Appendix C). *The Revised Science Attitude Scale* is a 22-item questionnaire (12 positive and 10 negative) using a five-point Likert scale ranging from *strongly agree* (5) to *strongly disagree* (1) for positively worded items. Negatively phrased items had their scores reversed. The original instrument was developed by Bitner (1994) from the work of Thompson and Shrigley (1986). The version used in this study was slightly modified by Choi (2007) to align with inquiry lessons in science; for example, "Teaching science takes too much time" was changed to "Teaching inquiry-based science takes too much time." The instrument is divided into four subcomponents: (a) comfort-discomfort of teaching science (items 1, 3, 6, 7, 9, 11, 14, 18, and 19), (b) basic needs of American students in science (items 2, 8, 15, 21, and 22), (c) time required to prepare and teach science (items 4, 13, and 20), and (d) handling of science equipment (items 5, 10, 12, 16, and 17) (Bitner, 1992), This instrument was designed to measure participants' attitudes or beliefs of science teaching and has scales to assess the inquiry component of science teaching, meeting the needs of this study. Using coefficient alpha, the reliability estimate for this scale was 0.89, and 0.85 for the subscale. The validity of content was established among four subcomponents as validity coefficients with a range from 0.46 to 0.70 (Bitner, 1994; Thompson & Shrigley, 1986).

The *Inquiry Beliefs and Practices* survey is a three-section instrument. Section one is demographic data, section two contains closed-ended survey items, and section three has open-ended questions pertaining to inquiry. This study used questions 1 through 12 of section two. The survey questions are related to what teachers say about their inquiry practices to determine the level of implementation of full inquiry lessons. Section two rated closed-ended inquiry process skills and authentic inquiry skills. The closed-ended survey items 1, 4, 5, 6, 7, 8, and 10 are designed to measure the teacher's use of general inquiry practices with their students. Items 11, 12, 14, 15, and 17 measure the complex scientific inquiry skills students should be doing in the classroom (Jeanpierre, 2006). The questions are rated from *almost never* (1) to *almost always* (5) for each item with a Likert five-point scale. Using Cronbach's alpha, the internal consistency was examined for each of the two subscales. The subscale of general inquiry practices was 0.731 and the subscale of complex inquiry practices was 0.859 (Jeanpierre & Hahs-Vaugh, 2008).

Procedures

The instruments for this study were distributed to teachers in August of 2008. Permission was obtained from the Human Subjects Protection Review Committee (Appendix D) and superintendents of the participating school districts to distribute the instruments. The researcher also obtained permission to distribute the instruments from the principal of each individual school within the district. The instruments were hand delivered to the participating schools' principals one week prior to the beginning of the 2008-2009 school year. The principals distributed the instruments to all K-5 teachers in their school system during their staff development time. The instruments were collected by the principal upon completion. The instruments took no longer than 15 minutes to complete. If unforeseen circumstances did not allow teachers to complete the instruments during the prescribed time or if a teacher was absent, instruments were placed in teachers' school mailboxes for them to complete and return to the principal. The researcher arranged a date within 2 weeks afer the start of school with the principal of each school for collecting the completed instruments.

Data Analysis

A significance level of 0.05 was used to test all hypotheses. Data were entered into SPSS for analysis. The statistical procedure of multiple linear regression was used to test all hypotheses of the study.

CHAPTER IV

ANALYSIS OF DATA

Introduction

The researcher's primary purpose was to evaluate if elementary school teachers' attitudes toward teaching inquiry-based science, their level of implementation of NSES concerning inquiry-based science, and the number of inquiry-based lessons used in the elementary science classroom were related. The predictors for teachers' attitudes were comfort and discomfort of teaching science, needs of students, time required to prepare and teach science, and handling of science equipment. The predictors for implementation of NSES were general inquiry practices and complex inquiry skills. The number of inquiry lessons completed in a single school year was also collected on the demographic survey. Multiple linear regression analysis was conducted to determine whether gender, school district, race, educational level, experience, grade taught, or number of science courses taken was a predictor of attitudes toward inquiry-based science teaching, implementation of NSES, or number of inquiry-based lessons used. Secondary analyses were conducted to determine whether there was a relationship between teachers' attitudes toward teaching inquiry-based science, teachers' inquiry practices, and the number of inquiry lessons taught in the elementary science classroom.

Description of Sample

A total of 814 surveys were delivered to seven school district superintendents for distribution to K-5 teachers. The return rate was 53%, yielding a final sample of 429 teachers. The frequencies and percentages of subjects by gender, race, experience, and degree are presented in Table 1. Seven of the respondents were male and 422 were female. The final sample of teachers was 89.5% Caucasian, 8.6% African American, and 1.9% other. Experience ranged from zero years to 38 years with 2 and 3 year teachers making up 6% each and ranking as the highest percentages. The academic degree held reported in the sample of teachers was bachelor's (54.7%), master's (43.0%), and Specialist (1.9%).

The frequencies and percentages of subjects by grade teaching, district, number of science courses completed, and number of inquiry lessons completed with students are presented in Table 2. Percentages of teachers by grade teaching were evenly distributed, ranging from 10.7% to 16.3%. Thirty-six teachers reported teaching multiple grades, making up 8.4% of the total sample. District one represents 33.5% of total teachers responding and district four represents 6.0%. For science courses taken, 19.5% of the teachers completed three courses, 17.7% completed two courses, and 9.8% reported completing zero science courses. One hundred and eighty teachers, representing 46.8% of the sample, reported that they completed zero inquiry-based lessons for the previous school year. Fifty-two teachers, 12.1%, reported eight or more inquiry lessons for the same time frame, while 45 teachers did not respond to this question.

The descriptive statistics for this study are listed in Table 3. In Table 3, based upon teachers' attitudes toward inquiry-based science, the mean, standard deviation, minimum, maximum, and number of responses are listed for the four subscales: comfort and discomfort; needs of students; time required; and equipment.

In Table 4, based upon teachers' beliefs and practices toward inquiry-based science, the mean, standard deviation, minimum, maximum, and number of responses are listed for the two subscales: general practices and complex skills.

Table 1

Frequencies and Percentages of Subjects by Gender, Race, Experience, and Degree

	n	%
Gender		
Male	7	1.5
Females	422	98.4
No Response	1	.2
Race		
Caucasian	385	89.5
African American	37	8.6
Hispanic	4	.9
Asian	1	.2
Other	1	.2
No Response	2	
Experience		
0-5	129	30.7
6-10	88	20.9
11-15	60	14.3
16-20	49	11.7
21-25	42	10.0
26-30	35	8.3
31-35	15	3.6
36-40	2	.5
No Response	10	
Degree		
Bachelor's	235	54.9
Master's	185	43.0
Specialist	8	1.9
No Response	2	

Table 2

Frequencies and Percentages of Subjects by Grade Teaching, District, Number of Science Courses, and Number of Inquiry Lessons Completed with Students

	n	%
Grade Teaching		
Kindergarten	58	13.5
First	67	15.6
Second	70	16.3
Third	69	16.0
Fourth	60	14.0
Fifth	46	10.7
Sixth	13	3.0
Multiple Grades	36	8.4
No Response	11	
District		
One	144	33.5
Two	47	10.9
Three	46	10.7
Four	26	6.0
Five	65	15.1
Six	60	14.0
Seven	41	9.5
No Response	1	
Science Courses		
0-2	153	37.9
3-5	188	46.5
6-8	47	11.6
9 or More	16	4.0
No Response	26	
Number of Inquiry Lessons Completed with Students		
0	180	46.8
1	34	7.9
2	19	4.4
3	38	8.8
4	34	7.9
5	18	4.2
6	6	2.4
7	4	0.9
8 or More	52	12.1
No Response	45	

Table 3

Descriptive Statistics for K-5 Teacher Sample

	N	Minimum	Maximum	Mean	St. Dev.
Comfort/Discomfort	429	1.56	5.00	3.60	0.662
Needs of Students	429	1.80	5.00	3.90	0.595
Time Required	429	1.67	5.00	3.47	0.718
Equipment	429	1.20	5.00	3.65	0.698

Note: Scale for Comfort/Discomfort, Needs of Students, Time Required, and Equipment was a 5-point Likert-type scale ranging from 1-5.

Table 4

Descriptive Statistics for K-5 Teacher Sample

	N	Minimum	Maximum	Mean	St. Dev.
General Practice	428	2.29	5.00	3.86	0.590
Complex Skill	422	1.00	5.00	2.58	1.04

Note: Scale for general practice and complex skill was a 5-point Likert-type scale ranging from 1-5.

Tests of Hypotheses

The hypotheses for this study are restated below. The results obtained from testing the hypotheses are discussed and a presentation of the findings is given below each hypothesis.

Hypothesis 1 stated: There is no significant relationship between the dependent variable of attitude toward the teaching of elementary school inquiry-based science as measured by The Revised Science Attitude Scale and the independent variable of gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses. This hypothesis required the testing of each of the four predictor variables for attitude, comfort and discomfort, needs of students, time required, and equipment. The findings for these four predictors of teacher attitude toward teaching inquiry-based elementary school science are summarized in Table 5.

Predictor variable for comfort and discomfort was found to be significant, $F(13, 376) = 3.084$, $p < .001$, $R^2 = .096$, with independent variables gender, $\beta = .112$, $t(375) = 2.26$, $p = .025$, and number of science courses taken, $\beta = .269$, $t(375) = 5.39$, $p < .01$, being statistically significant. All independent variables for comfort and discomfort are presented in Table 6. For gender, males scored 0.563 higher than females and for each additional science course taken, teachers scored 0.078 higher concerning comfort and discomfort controlling for all other independent variables.

Predictor variable for needs of students was found to be significant, $F(13, 376) = 2.359$, $p = .005$, $R^2 = .075$, with independent variables district four, $\beta = .123$, $t(375) = 2.20$, $p = .028$, grade taught, $\beta = .105$, $t(375) = 2.03$, $p = .043$, and number of science

Table 5

Summary of Predictors for Attitude

Predictor	Regression *df*	Residual *df*	R^2	F	*p*
Comfort	13	376	.096	3.084	<.001
Needs	13	376	.075	2.359	.005
Time	13	376	.076	2.378	.005
Equipment	13	376	.105	3.396	<.001

Table 6

Coefficients for Independent Variables Concerning Comfort

	B	β	*t*	*p*
Constant	3.30		19.14	.000
Gender	.563	.112	2.26	.025
District 1	-.038	-0.18	-.335	.738
District 2	.099	.047	.745	.457
District 3	-.027	-.010	-.193	.847
District 4	.149	.081	1.47	.144
District 5	-.014	-.007	-.130	.897
District 6	.073	.032	.603	.547
Ethnic Group	.001	.005	.085	.932
Master's	.011	.008	.153	.878
Specialist's	.263	.052	1.00	.317
Experience	.001	015	.278	.781
Grade Teaching	-.007	-.022	-.442	.659
Courses Taken	.078	.269	5.39	.000

courses taken, β = .192, *t*(375) = 3.80, $p < .001$ being statistically significant. All independent variables for needs of students are presented in Table 7.

District four teachers scored 0.205 higher than teachers from other districts, for every increase in grade level taught teachers scored 0.030 higher, and for each additional science course taken teachers scored 0.050 higher concerning needs of students controlling for all other independent variables.

Predictor variable for time required was found to be significant, $F(13, 376) = 2.378$, $p = .005$, $R^2 = .076$, with independent variables district three, β = -.104, *t*(375) = 1.97, $p = .050$, grade taught, β = .110, t(375) = 2.13, p = .034, and number of science courses taken, β = .167, *t*(375) = 3.31, $p = .001$, being statistically significant. All independent variables for time required are presented in Table 8.

District three teachers scored 0.305 lower than teachers from other districts, for every increase in grade level taught teachers scored 0.038 higher, and for each additional science course taken teachers scored 0.052 higher concerning time required controlling for all other independent variables.

Predictor variable for equipment was found to be significant, $F(13,376) = 3.396$, $p < .001$, $R^2 = .105$, with independent variables district two, β = .123, *t*(375) = 1.98, $p = .049$, district four, β = .152, *t*(375) = 2.78, $p = .006$, and number of science courses taken, β = .067, *t*(375) = 4.46, $p < .001$, being statistically significant. All independent variables for equipment are presented in Table 9.

District two teachers scored 0.274 higher than teachers from other districts, district four teachers scored 0.295 higher than teachers from other districts, and for each

Table 7

Coefficients for Independent Variables Concerning Needs of Students

	B	β	*t*	*p*
Constant	3.62		23.07	.000
Gender	.122	.027	.535	.593
District 1	-.002	-.001	-.024	.981
District 2	.232	.121	1.01	.056
District 3	-.104	-.042	-.800	.424
District 4	.205	.123	2.20	.028
District 5	-.002	-.001	-.018	.986
District 6	.096	.047	.873	.383
Ethnic Group	.010	.005	.089	.929
Master's	-.060	-.049	-.920	.358
Specialist's	.003	.001	.012	.990
Experience	-.001	-.014	-.250	.803
Grade Teaching	.030	.105	2.03	.043
Courses Taken	.050	.192	3.80	.000

Table 8

Coefficients for Independent Variables Concerning Time Required

	B	β	*t*	*p*
Constant	3.172		16.90	.000
Gender	.311	.057	1.15	.253
District 1	.156	.068	1.25	.212
District 2	-.002	-.001	-.017	.987
District 3	-.305	-.104	-.197	.050
District 4	.117	.059	1.05	.294
District 5	-.102	-.048	-.850	.396
District 6	.013	.005	.100	.920
Ethnic Group	.071	.030	.509	.611
Master's	-.085	-.059	-.110	.273
Specialist's	.220	.041	.771	.441
Experience	-.003	-.034	-.619	.536
Grade Teaching	.038	.110	2.13	.034
Courses Taken	.052	.167	3.31	.001

Table 9

Coefficients for Independent Variables Concerning Equipment

	B	β	*t*	*p*
Constant	3.224		17.9	.000
Gender	.484	.092	1.87	.063
District 1	-.069	-.031	-.581	.561
District 2	.274	.0123	1.98	.049
District 3	-.018	-.006	-.123	.903
District 4	.295	.152	2.78	.006
District 5	-.043	-.021	-.377	.706
District 6	.138	.058	1.09	.275
Ethnic Group	.076	.033	.569	.570
Master's	.019	.013	.251	.802
Specialist's	.391	.074	1.43	.153
Experience	-.002	-.023	-.419	.675
Grade Teaching	.021	.062	1.22	.223
Courses Taken	.067	.222	4.46	.000

additional science course taken teachers scored .067 higher concerning equipment controlling for all other independent variables.

With independent variables from all four predictors of teachers' attitudes toward inquiry-based science teaching indicating significance, Hypothesis 1 was rejected.

Hypothesis 2 stated: There is no significant relationship between the dependent variable of implementation of NSES for elementary science as measured by the Inquiry Beliefs and Practices and the independent variable of gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses. This hypothesis required the testing of each of the two predictor variables for implementation of inquiry-based science national standards, general practices, and complex skills. The findings for these two predictors of implementation of inquiry-based science standards are summarized in Table 10.

The implementation predictor of general practices, $F(13, 374) = 1.56, p = .094, R^2 = .018$, was found to be not significant for the model. The implementation predictor of complex skills was found to be significant, $F(13, 371) = 3.24, p < .001, R^2 = .102$. The independent variables of district four, $\beta = .114$, (370) = .207, $p = .040$, ethnic group, $\beta = -.184$, $t(370) = -3.16, p = .002$, and grade taught, $\beta = .199$, $t(370) = 3.91, p < .001$, were found to be statistically significant. All independent variables for complex skills are presented in Table 11.

District four teachers scored .326 higher than teachers from other districts, non-Caucasian teachers scored 0.638 lower than Caucasian teachers, and for each higher grade level taught teachers scored 0.099 higher concerning complex skills controlling for all other independent variables.

Table 10

Summary of Predictors for Implementation of Inquiry-based National Standards

Predictor	Regression *df*	Residual *df*	R^2	F	*p*
General	13	374	.051	1.560	.094
Complex	13	371	.102	3.238	.000

Table 11

Coefficients for Independent Variables for Complex Skills

	B	β	*t*	*p*
Constant	2.91		10.78	.000
Gender	-.458	-.059	-1.19	.234
District 1	.159	.049	.901	.368
District 2	.371	.112	1.80	.073
District 3	-.114	-.026	-.504	.615
District 4	.326	.114	2.07	.040
District 5	.201	.065	1.18	.240
District 6	.336	.097	1.81	.072
Ethnic Group	-.638	-.184	-.316	.002
Master's	-.126	-.061	-1.14	.255
Specialist's	.549	.071	1.36	.176
Experience	-.005	-.047	-.857	.392
Grade Teaching	.099	.199	3.91	.000
Courses Taken	.011	.024	.478	.633

With independent variables from the complex skills predictor indicating significance, Hypothesis 2 was rejected.

Hypothesis 3 stated: There is no significant relationship between the dependent variable of number of inquiry-based science lessons in the elementary school classroom as measured by demographic survey and the independent variable of gender, school district, ethnic group, educational level, years of teaching, science teaching assignment, and the number of science courses. The model for number of inquiry-based lessons, $F(13, 346) = 2.36$, $p = .005$, $R^2 = .082$, was found to be statistically significant. The results for all independent variables are presented in Table 12. The independent variables for gender, $\beta = .134$, $t(345) = 2.57$, $p = .010$, district three, $\beta = -1.29$, $t(345) = -2.00$, $p = .046$, and number of courses taken, $\beta = .130$, $t(345) = 2.48$, $p = .014$, were all statistically significant.

Male teachers used 2.81 more inquiry-based lessons than female teachers, district three teachers used 1.29 less inquiry-based lessons than teachers from other school districts, and for each additional science course taken teachers used 0.167 more inquiry-based lessons concerning number of inquiry-based lessons used controlling for all other independent variables.

Only three of the seven school districts included in this study were found to be significant predictors for the dependent variables examined. Figure 1 provides a summary for the occurrence of school districts as significant predictors in the seven school districts included in the study. District two was a significant predictor for the attitude subscale of equipment. District three was a significant predictor for the attitude subscale of time and the number of inquiry lessons completed during the previous school year. District four

Table 12

Coefficients for Independent Variables for Number of Inquiry Lessons Taught

	B	β	*t*	*p*
Constant	2.08		2.69	.008
Gender	2.80	.134	2.57	.010
District 1	.289	.031	.553	.581
District 2	-.754	-.080	-1.24	.214
District 3	-1.29	-.109	-2.00	.046
District 4	.504	.064	1.10	.271
District 5	-.424	-.049	-.853	.394
District 6	.210	.020	.363	.717
Ethnic Group	-.309	-.032	-.538	.591
Master's	.046	.008	.144	.886
Specialist's	2.18	.104	1.89	.060
Experience	.001	.035	.602	.547
Grade Teaching	-.021	-.015	-.284	.777
Courses Taken	.167	.130	2.48	.014

was a significant predictor for the attitude subscales of students' need for inquiry science and equipment along with the inquiry beliefs and practices subscale of complex skills. The remaining districts were not significant predictors for any dependent variables.

With three independent variables indicating significance, Hypothesis 3 was rejected.

Hypothesis 4 stated: There is no significant relationship between the attitude scores of the school district teachers as measured by The Revised Science Attitude Scale and the scores of implementation of NSES as measured by Inquiry Beliefs and Practices. A multiple regression analysis using the Pearson correlation technique was used to determine the relationship between the four predictors of teachers' attitudes toward teaching inquiry-based science and the two predictors of the implementation of NSES concerning inquiry-based science. Results of the test are presented in Table 13.

The data indicated significant positive correlations exist between Comfort/Discomfort and General Practices ($r = .307, p < .05$) along with Complex Skills $r = .336, p < .05$); Needs of Students and General Practices ($r = .343, p < .05$) along with Complex Skills ($r = .280$, p < .05); Time Required and General Practices ($r = .336, p < .05$) along with Complex Skills (r = .321, p < .05); and Equipment and General Practices ($r = .339$, p < .05) along with Complex Skills ($r = .364$, p < .05). Thus, Hypothesis 4 was rejected.

Hypothesis 5 stated: There is no significant relationship between the attitude scores of the school district teachers as measured by The Revised Science Attitude Scale and the number of inquiry-based lessons as measured by the demographic survey. A multiple regression analysis using the Pearson correlation technique was used to

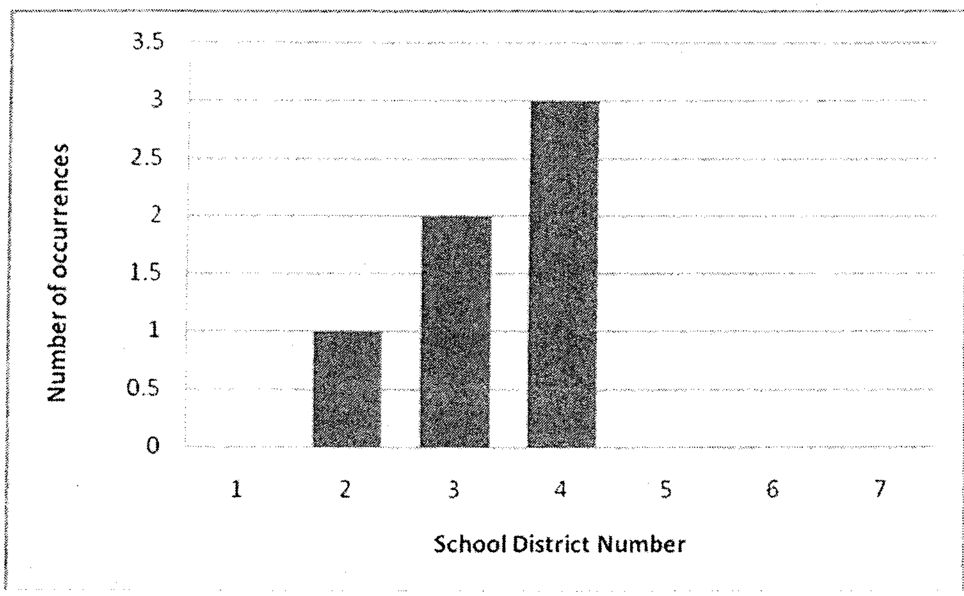

Figure 1. Summary of School Districts as Significant Predictors

Table 13

Correlations Between the Subscales of The Revised Science Attitude Scale and the Subscales of the Inquiry Beliefs and Practices Survey

	General Practice		Complex Skills	
	r	n	*r*	n
Comfort and Discomfort	.307*	427	.336*	422
Needs of Students	.343*	427	.280*	422
Time Required	.336*	427	.321*	422
Equipment	.339*	427	.364*	422

*Correlation is significant at the 0.01 level (2-tailed) determine the relationship between the four predictors of teachers' attitudes toward teaching inquiry-based science and the number of inquiry-based lessons used by teachers in the previous school year. Results of the test are presented in Table 14.

The data indicated a significant positive correlation exists between Comfort/Discomfort and Number of Inquiry-based Lessons ($r = .368, p < .05$), Needs of Students and Number of Inquiry-based Lessons ($r = .316, p < .05$), Time Required and Number of Inquiry-based Lessons ($r = .370, p < .05$), and Equipment and Number of Inquiry-based Lessons ($r = .322, p < .05$). Thus, Hypothesis 5 was rejected.

Hypothesis 6 stated: There is no significant relationship between the implementation of NSES as measured by the Inquiry Beliefs and Practices and the Number of Inquiry-based Lessons used as measured by demographic survey. A multiple regression analysis using the Pearson correlation technique was used to determine the relationship between the two predictors of teachers' implementation of inquiry-based science national standards and the Number of Inquiry-based Lessons Used by teachers in the previous school year. Results of the test are presented in Table 15.

The data indicated a significant positive correlation exists between General Practices and Number of Inquiry-based Lessons Used ($r = .310, p < .05$) and between Complex Skills and Number of Inquiry-based Lessons Used ($r = .364, p < .05$). Thus, Hypothesis 6 was rejected.

Ancillary Findings

Elementary teachers were asked to provide a description of the inquiry-based lessons they had completed with their students. The data for number of inquiry-based

Table 14

Correlations Between the Subscales of The Revised Science Attitude Scale and the Number of Inquiry-based Lessons Used

	Number of Inquiry-based Lessons Used	
	r	n
Comfort and Discomfort	.368*	385
Needs of Students	.316*	385
Time Required	.370*	385
Equipment	.322*	385

*Correlation is significant at the 0.01 level (2-tailed)

Table 15

Correlations Between the Subscales for Implementation of Inquiry-based National Science Standards and the Number of Inquiry-based Lessons Used

	Number of Inquiry-based Lessons Used	
	r	n
General Practices	.310*	383
Complex Skills	.364*	380

*Correlation is significant at the 0.01 level (2-tailed) lessons used by teachers is presented in Table 2 and the number of teachers responding concerning an inquiry-based lesson is presented in Table 16.

Two hundred and five teachers reported completing one or more inquiry-based lessons with their students. One hundred and eight teachers provided a description of an inquiry-based lesson completed with their students. Ninety-seven, or 47%, of teachers who reported completing one or more inquiry-based lessons with their students provided no description of a lesson.

The inquiry lessons described by the 108 teachers varied greatly. Many teachers simply listed a few titles of lessons they have completed with their students. The titles included volcanoes, rock collections, planting seeds, and water cycle. The teachers chose to provide no further description of these lessons making it impossible for the researcher to determine if inquiry-based instruction was conducted. Several other teachers described classroom experiments, science fair projects, hands-on activities, and group work as examples of inquiry lessons. These lessons are worthwhile in the elementary classroom but contained very few of the descriptors of an inquiry-based lesson. Lastly, one teacher described a lesson where her students asked questions they wanted to know about the growth process of plants, grew a class garden, investigated their questions, and reported their findings to the class. Examples like the previous one of an inquiry lesson were very few, with most of the descriptions being along the lines of traditional science lessons.

Table 16

Frequencies and Percentages of Teachers' Descriptions of Inquiry-based Lessons

	n	%
Number Not Providing a Description	319	74.2
Number Providing a Description	108	25.1
No Response	3	

CHAPTER V

SUMMARY AND CONCLUSIONS

Purpose

The purpose of this study was to examine the relationship between the three dependent variables of K-5 elementary teachers' attitudes toward, implementation of, and number of inquiry-based science lessons used and the predictor variables of gender, school district, ethnic group, educational level, experience, grade teaching, and number of science courses taken. The goal was to provide information about the factors related to teachers' attitudes toward, implementation of, and number of inquiry-based lessons among K-5 elementary teachers in order to add to the existing research and to provide support data for a grant providing equipment and training for the school districts participating in the study.

Summary of the Procedures

This study of seven school districts in south Mississippi collected data from 429 kindergarten through fifth grade elementary school teachers. All subjects participated voluntarily.

Data were gathered using three instruments. The Revised Science Attitude Scale (Bitner, 1994) was slightly modified by Choi (2007) to include inquiry-based statements. The Revised Science Attitude Scale includes four subscales, each with a separate score, related to attitude toward inquiry-based science teaching. The Inquiry Beliefs and Practices survey (Jeanpierre, 2006) includes two subscales. One subscale measures teachers' general inquiry practices while the second subscale measures complex inquiry skills. The variables of gender, school district, ethnic group, educational level, experience, grade teaching, number of science courses taken, and number of inquiry lessons used in the previous school year were reported by participants on a Demographic Information Questionnaire.

Data for all variables were collected by the researcher in August and September of 2008. The researcher scored the Revised Science Attitude Scale, Inquiry Beliefs and Practices survey, and the Demographic Information Questionnaire. Multiple linear regression analysis and Pearson correlation were used to test the hypotheses of this study. An alpha level of .05 was used in all tests of hypotheses. The statistical package SPSS 16.0 was used to perform the required calculations.

Conclusions

1. The number of science courses taken by teachers was found to be a significant predictor of their attitude toward inquiry-based science teaching for all four subscales and the number of inquiry-based lessons used in the elementary classroom. This significance suggests that teachers taking more science courses report a more positive attitude toward inquiry-based science teaching and they use more inquiry-based lessons with their students.

2. Gender was found to be a significant predictor of attitude for the subscale comfort and discomfort. This significance suggests that male teachers report a more positive attitude for comfort toward inquiry-based science teaching.

3. Teachers employed in district number four and grade level teaching were found to be significant predictors of attitude for the subscale of the need students have for science. This significance suggests that teachers from district four and teachers teaching

higher grade levels report a more positive attitude for the students' need concerning inquiry-based science teaching.

4. Teachers employed in district three and grade level teaching were found to be significant predictors of attitude for the subscale time required for teaching inquiry-based science. This significance suggests that teachers from district three and teachers teaching higher grade levels report a more positive attitude for time required concerning inquiry-based science teaching.

5. Teachers employed in districts two and four were found to be significant predictors of attitude for the subscale equipment. This significance suggests that teachers from districts two and four report more positive attitudes for equipment concerning inquiry-based science teaching.

6. Teachers' general practices concerning their inquiry beliefs were not a significant predictor; however, the variables of district four, ethnic group, and grade level teaching for the complex skills subscale were found to be significant predictors of teachers' beliefs and practices. This significance suggests that teachers from district four, Caucasian teachers, and teachers teaching higher grade levels report a greater use of complex skills concerning inquiry-based teaching.

7. Teachers employed in district three and gender were found to be significant predictors of the number of inquiry-based science lessons used in the elementary classroom. This significance suggests that teachers from district three and male teachers overall use more inquiry-based lessons in their elementary classrooms.

8. All of the four subscales for the Revised Science Attitude Scale are positively correlated to the two subscales for the Inquiry Beliefs and Practices survey.

This correlation suggests that the teachers' attitudes toward inquiry-based science teaching positively impact their practices concerning inquiry-based teaching in their classrooms.

9. All four subscales for the Revised Science Attitude Scale and the two subscales of the Inquiry Beliefs and Practices survey are positively correlated to the number of inquiry-based lessons used in the elementary classroom. This correlation suggests that teachers' attitudes toward inquiry-based science teaching and the teachers' practices concerning inquiry-based science have a positive impact on the number of inquiry-based lessons used in the elementary classroom.

10. The mean score for the subscale general practices of the Inquiry Beliefs and Practices survey is higher than the mean score of the subscale complex skills for the same instrument. This difference suggests that what teachers report they are doing in their classrooms is not in alignment with the processes they are actually carrying out in their classrooms concerning inquiry-based teaching.

Discussion

The National Science Education Standards (NSES) recommend that students in all grades have the opportunity to use scientific inquiry (NRC, 1996). The National Science Teachers Association (NSTA) has taken the position that inquiry science must be a basic in the daily curriculum of every elementary school student (NSTA Official Positions, 2002). The literature has established that the attitude of the teacher, whether positive or negative, is related to student performance (Talsma, 1996; Watters & Ginns, 1995; Young, 1998) and students' enthusiasm can be molded by the teacher's attitude (Rhoton & Shane, 2006). The literature related to teacher attitude also has established that teachers with high self-efficacy will carry out more inquiry-based lessons with their students (Plourde, 2002). Researchers have examined the implementation of NSES concerning inquiry-based science teaching, and the process of implementation has encountered many barriers. Teachers' responses concerning their own classrooms indicate they are carrying out general inquiry practices, but when they are questioned about the complex skills they are asking their students to complete in the classroom, they are not truly engaging their students in inquiry-based lessons (Jeanpierre, 2006). The present study of K-5 elementary school teachers from seven south Mississippi school districts sought to examine the attitudes toward inquiry-based instruction, implementation of inquiry-based lessons, and the number of inquiry-based lessons used. The relationship between the three was also examined. This study examined the relationship between the above-mentioned areas and the factors of gender, school district, ethnic group, educational level, experience, grade level teaching, and number of science courses completed.

Within this study the attitudes of south Mississippi teachers was found to be slightly below the established means of other teachers completing the Revised Science Attitude Scale (Bitner, 1994). The findings of this study are in agreement with the work of Jeanpierre (2006) as south Mississippi K-5 teachers report completion of general practices at a high level, but their responses concerning complex inquiry skills are much lower. The number of inquiry-based lessons used in the elementary classroom is not well documented in literature. This study found that over one half of the teachers surveyed either reported completing zero inquiry-based lessons or they did not respond to the survey question.

Correlations were found between the four subscales for attitude with both subscales for implementation and the number of inquiry-based lessons completed. This finding was consistent with other findings indicating that attitudes toward inquiry-based science are related to the number of inquiry-based lessons used in the elementary classroom (Plourde, 2002; Ginns & Watters, 1998). The relationship of teachers' attitudes toward inquiry-based science methods and implementation of NSES concerning inquiry-based lessons is not addressed in the literature. This study shows that attitude toward inquiry-based science is positively related to the implementation of NSES concerning inquiry-based instruction.

Number of science courses completed was found to be a significant predictor of teachers' attitudes toward inquiry-based science and the number of inquiry-based lessons completed with students. Within this group of participants, those with more science courses completed had more positive attitudes toward inquiry-based science teaching for all four subscales and reported completing more inquiry-based lessons with their students. This study found no correlation between the number of science courses taken and the subscale of complex skills for inquiry beliefs and practices. Research has shown that an increase in content knowledge, i.e., more science courses, will better prepare teachers to teach science (Appleton & Kindt, 1999; Davis, 2003; Gee, Boberg & Gabel, 1996; Gee & Gabel, 1996; Kennedy, 1997; Parker & Heywood, 2000). However, teachers completing science courses taught by traditional methods have not necessarily been successful at implementing inquiry-based lessons (Bleicher & Lindgren, 2005; Smith & Anderson, 1999; Smith & Gess-Newsome, 2004; Spector & Strong, 2001; Tosun, 2000). The findings of this study are consistent with the literature.

Gender was found to be a significant predictor for teachers' attitudes, but only for the comfort and discomfort subscale, and gender was also found to be a significant predictor for the number of inquiry-based lessons used with students. Male teachers were found to have a more positive attitude toward inquiry-based science and to complete more inquiry-based science lessons with their students. This finding is not addressed in the literature.

The relationship between teachers' attitudes toward inquiry-based science or number of inquiry-based lessons taught and school district is not addressed in the literature. School district was found to be a significant predictor of teacher attitude in a few cases and also for the number of inquiry-based lessons completed with students. This study shows that district four teachers have a more positive attitude for the needs and equipment subscales, district three teachers for the subscale of time required, and district two teachers for the equipment subscale for attitude. This study also indicates that district three teachers complete more inquiry-based lessons with their students than the other six school districts.

The grade level teaching was found to be a significant predictor for attitude, but only for needs and time required subscales. For the participating teachers, the teachers of higher grade levels have a more positive attitude toward inquiry-based teaching.

Limitations

This study was limited as follows:

1. Data collection methods were limited to self-reported data not verified by classroom observations and teacher interviews.

2. The population surveyed was predominately Caucasian and female. The number of males available to participate in the study from K-5 grades was small in the selected school districts (N = 7). The study may not be generalizable beyond a similar sample.

3. The sample size of this study was relatively small. Only seven school districts were surveyed, and this small sample size may affect the generalizability to other districts.

4. It must be assumed, but cannot be guaranteed, that all teachers involved in the study were administered the survey in an identical fashion.

5. The definition of inquiry-based lessons varies greatly in the literature. It must be assumed that the teachers participating in this study have an accurate understanding of inquiry-based lessons.

Recommendations for School Districts

School districts need to establish district-wide professional development goals concerning the NSES, especially in the area of inquiry-based instruction. The goals should be developed by all stakeholders from the superintendent to the classroom teacher. The principals, as instructional leaders, should implement a training program that will meet the professional development goals of the district. In the planning of a training program, needs assessment for each individual school within a district should be completed. The professional development should review NSES and train teachers about inquiry learning by teaching with inquiry learning methods. Research indicates that successful inquiry-based training, whether through professional development or college courses, must be taught with inquiry-based methods (Barnet et al., 2004; Bleicher &

Lindgren, 2005; Hubbard & Abell, 2005; Luera et al., 2005; Luera & Otto, 2005; Weld & Funk, 2005). School districts should employ a science education specialist to assist K-5 teachers with implementation of inquiry-based teaching methods. These specialists should serve as mentors, classroom observers, content experts, and resource providers for the teachers as they develop their inquiry-based science teaching skills.

The number of inquiry-based science lessons should be increased throughout the K-5 classrooms. With district teachers self-reporting the completion of zero inquiry-based lessons for the 2007-2008 school year or either not answering the survey question concerning the number of inquiry-based lessons being at a level of 50%, school districts should be concerned about how well their school systems are implementing the NSES concerning inquiry learning for their elementary students.

Recommendations for Future Research

Based on the results of this study, several suggestions are offered for future studies related to teachers' attitudes toward and teachers' implementation of inquiry teaching methods.

1. Replicate the study with classroom observations and teacher interviews. In this study, the researcher distributed and collected self-reported questionnaires. With classroom observations and teacher interviews, the researcher will be able to better judge what inquiry methods are actually being used in the K-5 elementary classroom.

2. Replicate the study with a larger sample size from the state of Mississippi. A statewide study would provide increased validity to the results and could possibly lead to evidence of the need for statewide training in inquiry-based teaching methods.

Additional male and minority subjects would allow more valid examination of the relationships between the independent and dependant variables of the study.

3. A study should be conducted to determine K-5 teachers' definition and understanding of an inquiry lesson. This researcher received unsolicited comments such as "I don't know what you mean by inquiry learning" or "What is inquiry-based learning?" Developers of teacher training programs and professional development for school districts could benefit from knowing the status of their teachers' understanding of inquiry-based lessons.

4. A study should be conducted to determine the attitudes of district superintendents and principals toward science education, inquiry-based methods, and the NSES. These individuals make decisions concerning funding, training, and instructional priorities. The emphasis these individuals place on science education guides the district. Knowing their attitudes concerning inquiry-based methods and the implementation of NSES would give insight into the district's direction in the area of science education.

APPENDIX A

LETTER TO SUPERINTENDENTS

91 Rogers Road
Hattiesburg, MS 39401
March 21, 2008

Name, Superintendent
School
Address
City, State, Zip

Dear Superintendent,

I am a science teacher/boy's basketball coach at Forrest County AHS and a doctoral student at The University of Southern Mississippi. I am pursuing a doctorate from The University of Southern Mississippi in physics education. My dissertation is dealing with K-5 teachers' attitudes concerning and implementation of inquiry-based methods in their elementary classrooms.

With your permission, the district would receive surveys for each of the K-5 teachers to be completed during August staff development for the 2008-2009 school year. The survey requires approximately 15 minutes for completion. Confidentiality will be maintained throughout this study. The names of individual teachers will not be collected within this study.

I would appreciate your permission for the teachers in your district to participate in this study. Please e-mail or mail me a letter stating that I have permission to conduct this study. If I need to supply any further information, please let me know. Thank you for your cooperation and assistance.

Sincerely,

Thomas F. Sumrall
tsumrall@forrestcountyahs.com
(601-297-0485 (cell)

APPENDIX B

LETTER TO ADMINISTRATORS

Thomas F. Sumrall
91 Rogers Road
Hattiesburg, Ms 39401
tsumrall@forrestcountyahs.com
601-297-0485

Dear Administrator:

I am a doctoral student at The University of Southern Mississippi. I am conducting a doctoral study concerning K-5 elementary teachers' attitudes and beliefs toward inquiry science and their implementation of inquiry methods in their classrooms. This study will include only K-5 teachers in your district.

Permission has been granted from your superintendent to conduct this study within your district. The survey consists of a demographic sheet, *The Revised Science Attitude Scale* instrument, and the *Inquiry Beliefs and Practices* instrument. I ask that you distribute and collect these instruments during your staff development days prior to the beginning of the 2008-2009 school year. An envelope has been provided for you to place the survey in, and I will arrange a time to pick them up from you.

Since I am a practicing school teacher, I know the demands of beginning a new school year. However, I hope that you will find the time to assist me in completing this survey. This should take no more than 15 minutes out of your teachers' busy schedules. Anonymity and confidentiality will be maintained throughout this study.

If you have any concerns or questions, please feel free to contact me by telephone or e-mail. Thank you for your time and cooperation in advance.

Sincerely,

Thomas F. Sumrall
Enclosures

APPENDIX C

SURVEY INSTRUMENTS

Demographic Information

Please complete the following:

1. What is your gender? Male _____ Female _____
2. What is your race?

   1 Caucasian/White _____
   2 African American _____
   3 Hispanic/Latino _____
   4 Asian/Pacific Islander _____
   5 American Indian _____
   6 Other

   ____
   Please specify

3. How many years of teaching experience do you have? _____ year(s)
4. What grade will you be teaching this school year?

   K _____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____

5. Name of school district where you teach ___________________
6. What academic degree do you hold?

   1 bachelor's degree (B. A., B.S.) _____
   2 master's degree (M.A., M.S.) _____
   3 Specialist _____
   4 other _________________ please specify

7. What was your major field of study?

   1 Education _____
   2 English _____
   3 Mathematics _____
   4 history/social science/social studies ______
   5 Natural/physical sciences _____
   6 Foreign Language _____
   7 Special Education _____
   8 Physical Education _____
   9 Other _________________ please specify

8. How many undergraduate or graduate courses have you taken in science area? Please report the number of courses, not credit hours.

   0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9 ___ 10 or more ___

9. How many inquiry based lessons did you complete with your students during the 2007-2008 school year?

   0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 or more ____

10. If you have taught 1 or more inquiry lessons, please describe them briefly below:

The Revised Science Attitude Scale

Please use the rating which best describes your attitude toward the following statements.

5 = strongly agree, 4 = agree, 3 = undecided, 2 = disagree, 1 = strongly disagree

1.	I will feel uncomfortable teaching inquiry-based science.	5 4 3 2 1
2.	The teaching of science processes is important in the elementary classroom.	5 4 3 2 1
3.	I fear that I will be unable to teach inquiry-based science lessons adequately.	5 4 3 2 1
4.	Teaching inquiry-based science takes too much time.	5 4 3 2 1
5.	I will enjoy the lab period in the science courses that I teach.	5 4 3 2 1
6.	I have a difficult time understanding science.	5 4 3 2 1
7.	I feel comfortable with the science content at the elementary school level.	5 4 3 2 1
8.	I would be interested in working on inquiry-based science curriculum.	5 4 3 2 1
9.	I dread teaching inquiry-based science lessons.	5 4 3 2 1
10.	I am not afraid to demonstrate science phenomena in the classroom.	5 4 3 2 1
11.	I am not looking forward to teaching science as inquiry in my elementary classroom.	5 4 3 2 1
12.	I will enjoy helping students construct science equipment.	5 4 3 2 1
13.	I am willing to spend time setting up equipment for a lab.	5 4 3 2 1
14.	I am afraid that students will ask me questions that I cannot answer.	5 4 3 2 1
15.	Science is as important as the 3 R's (reading, writing, language arts)	5 4 3 2 1
16.	I enjoy manipulating science equipment.	5 4 3 2 1
17.	In the classroom, I fear science experiments won't turn out as expected.	5 4 3 2 1
18.	Science would be one of my preferred subjects to teach, if given a choice.	5 4 3 2 1
19.	I hope to be able to excite my students about science as inquiry.	5 4 3 2 1
20.	Teaching inquiry-based science takes too much effort.	5 4 3 2 1
21.	Children are not curious about scientific matters.	5 4 3 2 1
22.	I plan to integrate science into other areas.	5 4 3 2 1

Inquiry Beliefs and Practices

Please use the rating which best describes your inquiry teaching and learning beliefs.

5 = almost always, 4 = often, 3 = sometimes, 2 = seldom, 1 = almost never

1. I am a facilitator of students' learning.	5 4 3 2 1
2. I welcome students' questions	5 4 3 2 1
3. I encourage students to seek answers to their own questions.	5 4 3 2 1
4. I ask students what they are interested in learning.	5 4 3 2 1
5. I use students' interests as a guide when constructing my lessons.	5 4 3 2 1
6. I use discrepant events to motivate students.	5 4 3 2 1
7. I do not depend on the textbook.	5 4 3 2 1
8. I focus on students' understanding of science concepts.	5 4 3 2 1
9. I have students working on different research questions during a class period.	5 4 3 2 1
10. I have students develop their own hypotheses.	5 4 3 2 1
11. I have students design their own experiments.	5 4 3 2 1
12. I have students analyze data based on their own research.	5 4 3 2 1
13. I have students interpret their data based on their research evidence.	5 4 3 2 1
14. I have students read the research of others in the science community which relates to their own research prior to deciding on a research question.	5 4 3 2 1
15. I have students communicate their research results to their peers.	5 4 3 2 1
16. I have students share their research results in a formal out-of-class setting (i.e., science fair competition).	5 4 3 2 1
17. I provide students with science inquiry experiences that are balanced between developing their research skills and concept understanding.	5 4 3 2 1

APPENDIX D

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **28060204**
PROJECT TITLE: **South Mississippi Public Elementary School Teachers' Implementation of and Attitudes Toward Inquiry-Based Science**
PROPOSED PROJECT DATES: **07/31/08 to 10/03/08**
PROJECT TYPE: **Dissertation or Thesis**
PRINCIPAL INVESTIGATORS: **Thomas Franklin Sumrall**
COLLEGE/DIVISION: **College of Science & Technology**
DEPARTMENT: **Center for Math and Science**
FUNDING AGENCY: **N/A**
HSPRC COMMITTEE ACTION: **Expedited Review Approval**
PERIOD OF APPROVAL: **07/15/08 to 07/14/09**

Lawrence A. Hosman
Lawrence A. Hosman, Ph.D.
HSPRC Chair

7-17-08
Date

APPENDIX E

LETTERS OF SUPPORT

University of Central Florida

Department of Teaching & Learning Principles

May 13, 2008,

To Whom It May Concern:

I grant permission to Mr. Tommy Sumrall, University of Southern Mississippi to use the *"Teachers' Inquiry Beliefs"* survey ,which I am the author. The permission is granted for use of this survey as a data collection instrument for his doctoral thesis.

Regards,

Bobby Jeanpierre

Bobby Jeanpierre, Ph.D.
University of Central Florida
College of Education
Department of Teaching and Learning Principles
(O) 407-823-4930
bjeanpie@mail.ucf.edu

WILSON
COLLEGE

April 21, 2008

Mr. Tommy Sumrall
91 Rogers Road
Hattiesburg, MS 39401

Dear Mr. Sumrall:

I am pleased to grant you permission to use the "Revised Science Attitude Scale for Pre-service Elementary Teachers" in your dissertation research. In addition, I am also encouraging you to attempt to contact Shrigley and Johnson regarding the scale.

Since I am retiring August 2008, please plan to send your results to my home address: Dr. Betty L. Bitner, 1124 Levi LN., Chambersburg, PA 17201-4128.

Good luck in your dissertation research.

Sincerely,

Betty L. Bitner

Betty L. Bitner, Ed. D.
Professor of Education
Director of the Master of Education Degree Program
Wilson College
Warfield #008
1015 Philadelphia Avenue
Chambersburg, PA 17201
bbitner@wilson.edu
717-264-4141, ext. 3109
FAX: 717-262-2579

Tommy Sumrall
University of Southern Mississippi
Hattiesburg, MS.

March 13, 2008

Dear Mr. Sumrall,

You have my permission to use a modified version of the Revised Science Attitude Scale (Bitner, 1994) in your research.

Best regards,

Sanghee Choi, Ed.D
University of Houston
sc1122@att.net

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