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Science Inquiry Kits And Teacher Preparedness To Teach Science As Inquiry In Elementary Classrooms

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SCIENCE INQUIRY KITS AND TEACHER PREPAREDNESS TO TEACH SCIENCE AS INQUIRY IN ELEMENTARY CLASSROOMS

by

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ABSTRACT

The National Science Education Standards (1996) indicate that science education should include inquiry instruction. Many teachers still struggle with how to implement inquiry in their classrooms and a lack of high quality inquiry-based instructional materials has been posited as a hindrance. The purpose of this qualitative study was to observe the instructional practices of three elementary teachers when using an inquiry-based science kit program in their fourth grade classrooms. Teacher practices and their attitudes towards their preparedness to teach science with the support of the curricular program were examined. Data were collected through pre/post survey comparisons, observations, and a focus group session. Results indicated that these teachers' attitudes were positively impacted. Teachers' access to science kits provided resources which facilitated more inquiry experiences with their students; however, resources alone did not fully address teacher science content needs.

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develop “habits of mind” to think critically, deeply, and analytically. And for that, I have grown and I foresee that I will continue to grow in ways I never thought possible.

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CHAPTER ONE: INTRODUCTION

Since 1996, the National Science Education standards have called for reform in science education (NRC) to include inquiry instruction. Sadly, more than ten years later, many teachers still struggle to implement inquiry in the classroom because they do not have the tools to help them implement the strategies effectively. As the school's Curriculum Resource Teacher, I was in a position to see the need for all grade levels to incorporate more science instruction. The fact of the matter is that if our students were to become more proficient in science, they had to be engaged in science instruction. The need for good science instruction was now! I wanted to do this study so that I could learn how I could best help support classroom teachers in using the adopted science curricular program and kit materials with their students.

Three fourth grade teachers agreed to participate in my action research project with the desire that we would be able to gain insights into the benefits and challenges of using an inquiry based program to support science instruction in the classroom. The premise of having three professional perspectives to draw from would allow for a diversity of perceptions on the subject. I was afforded the opportunity to observe teacher classroom practices up close and personal in an effort to gain insight into how science kit materials affected teacher practices.

Through my participation in the Lockheed Martin program, I was exposed to various science teaching strategies with numerous opportunities to reflect on my own teaching practices. As part of this self-analysis I realized that during the initial years of teaching, I relied very heavily on the strong support of my grade level team, personal beliefs about teaching and learning, curriculum materials provided, experience that only time provides, and the rosy picture of my own successful educational experiences as a student learner. I was fortunate to be part of a grade level team that worked collaboratively with each other, which provided excellent support as well as opportunities for professional development and educational dialogue. Together, we developed many activities that facilitated student learning and led to many unique opportunities for all of our students.

In spite of working together with all these positive things in our favor, I felt that we struggled in the area of science. I often found myself teaching science using the traditional teaching methods from which I had learned during most of my own career as a student. In hindsight, I realized that we spent a lot of time reading about science versus actually "doing" science. Occasionally, I did a hands-on activity with the students to interject some fun while learning, and although we covered all the content material the Florida Sunshine State Standards required, I felt that I could and should provide my students with more relevant and meaningful experiences in science that would peak their interests and help them become critically thinking, problem-solving students.

I was excited when our school district adopted a nationally produced science textbook and materials kit program. One of the key components of this program was the science experiment kit, which provided teachers with ample, organized resources and materials to engage students in inquiry learning experiences. As a grade level team, we were excited with this new series, and even attended the district sponsored training together during the summer. To be honest, we were euphoric at the end of the ½ day training session. I came away with a sense of excited optimism and a feeling that I had been graced with the "answer" to our needs. Much to my chagrin, this feeling of euphoria dissipated once we returned at the beginning of the next school year and faced delays in receiving all the materials. These delays contributed to our falling behind the recommended pacing guide and created frustration for the team collectively, and for me personally as well.

The next year we fared better in the sense that we began with all the components of the program, but I felt that there was some regression as teachers seemed reluctant to use the program. This attitude was not only on my team and throughout my school, but it seemed to have infiltrated the entire district as well. Often, during the course of the year, I had opportunities to meet and dialogue with other teachers and found that there was inconsistent use of the program. Some teachers had not used the materials kit at all.

At the same time, I began using more of the program and developing my pedagogical knowledge in the area of teaching and learning, largely as a result of pursuing my master's degree. I spent the entire year using the program and believed it to be of value in the teaching and learning of science. I wanted the rest of my team to be as energized as I was about the program's potential, and shared this during several team planning sessions.

It was those discussions that led to this action research project. When we took an honest assessment of the amount of time spent on science instruction and its priority in relation to reading, math and writing, we had to admit that science instruction was less of a priority. Furthermore, we acknowledged that although fourth graders were not assessed in science on the Florida Comprehensive Assessment Test (FCAT), we needed to do more to help prepare our students. We recognized the critical need to expose students to science instruction prior to the tested grade because students needed repeated exposure in the practice of science.

Purpose of the Study

The purpose of this study was to investigate teachers' practices in using an inquiry based science kit program in fourth grade classrooms. Data were obtained from teacher surveys, focus group discussion, observations, and field notes. These research questions were explored:

1. How well prepared did teachers feel when using a curricular program with inquiry kit materials to teach science as inquiry?
2. How did teachers use the curricular program with inquiry kit resources in the classroom?

Rationale for the Study

The results of the Nation's Report Card Science 2005 indicate that although students in grade four are making progress when compared to the results from 1996 and 2000, only twenty-nine percent of the sample of fourth grade students tested nationally performed at or above the proficient level (NAEP, 2005). Students performing at this level are those who demonstrate mastery of challenging subject matter as opposed to students performing at a basic level, who have reached only partial mastery of science knowledge and the ability to apply the knowledge (NAEP, 2005). This number presents a particularly disturbing picture in the sense that it highlights the fact that the majority of our students nationally have only a basic understanding of nationally set scientific standards.

This is also consistent with statewide trends. FCAT Science scores for fifth grade students from 2003 through 2007 continue to present a dismal picture of science proficiency for Florida students. Results indicated that the majority of the students did not demonstrate proficient knowledge and application of the Florida Sunshine State Standards' in science education. According to the Florida Department of Education (2007b), 28% of the students tested scored at or above the minimum proficiency level of 3 in 2003; in 2004, 29% of the students scored at or above this level; in 2005, this number rose to 33%; in 2006, 35% of the students scored at or above the proficiency level; and in 2007, 42% of the students scored at or above the proficiency level. While this percentage has increase each year, these latest numbers indicate that more than half the students in Florida are not meeting the expectations, in terms of science knowledge, for the fifth grade.

Yet, the U.S. Department of Education (2002) reported that as a result of No Child Left Behind legislation, which was passed on January 8, 2002, there have been improvements in fourth grade student's reading proficiency as measured by the FCAT. While this is wonderful news, why aren't we making the same progress in science? With a finite amount of instructional time, in an age of ever increasing accountability and high stakes testing, tested subjects such as reading, writing, and mathematics, often take precedence over science in Kindergarten through fourth grades.

If we stop to analyze the environment in which we live today, we would quickly realize that we are in an age where science and technology abound, as does the need for individuals who will be able to think, act, and solve problems critically. Such is the age in which we live. This next generation of thinkers is today's youth. If we are struggling to meet our state and national standards, how will we be able to compete with other countries?

This question seems to be one that our state has contended with ever since the development of the Sunshine State Standards in 1996. The Florida Department of Education (2007c) states that "ample evidence from both national and international measures of student achievement indicated the urgent need for even higher expectations for all of our students" (p.5). Currently, Florida is implementing revised standards in many content areas, including science in order to "set the stage for higher levels of rigor and higher academic achievement for decades to come" (Florida Department of Education, 2007b, p.5). So the bar is being raised.

I believe that if we are to attain these expected levels of rigor and high academic achievement in science, we must look at how we approach the teaching and learning of science and be willing to change our practices where needed. Furthermore, I believe that teachers are at the heart of this change, and need to play an integral role in facilitating the changes that the standards will require. However, teachers won't know what needs to change unless they analyze their current practices. As educators, we can not solely focus on subject areas tested at specific grade levels alone.

Significance of Study

The National Research Council (1996, 2000) and others (Carin & Bass, 2001; Llewellyn, 2002) indicate that the quality of student learning can be increased through the use of inquiry teaching. The use of science educational programs with an emphasis on inquiry kit materials is one trend in the evolution of science curricula. Analyzing teacher practices when it comes to using the kit based materials with students is important to understanding the effectiveness of these materials. This study aimed to better understand the relationship between the use of the components of the program and teacher attitudes about their preparedness to teach science content and facilitate inquiry experiences for students. Because this study reviewed teacher practices in using kit based materials, the results may also be indicative of areas in which support is needed for teachers using this and similar curricular programs by revealing both the successes and challenges teachers experience in using such programs.

Limitations of Study

One limitation of this study was that information was based on the self-reporting of each individual teacher. It was assumed that teachers reported perceptions, strengths and weaknesses with honesty and candor. Another limitation of this study was that it was conducted using specific inquiry program materials and may have limited generalizability when compared to the use of other materials. In addition, participants in the study were all fourth grade teachers. Experiences at other grade levels might differ from this study's findings.

Definitions

Attitudes – A mental position, a feeling or emotion with regard to a fact or state (Merriam-Webster Online Dictionary, 2008). In this study, this term refers to teacher perceptions, feelings and emotions towards instructional strategies and curricular reform.

Beliefs – Personal convictions or ideas one holds ((Haney, Lumpe, Czerniak, & Egan, 2002)

Challenges – Factors that interfere with or impede the teachers' ability to conduct instruction.

Continuum of Inquiry – a series of developmental stages through which students progress as they experience the inquiry learning process and acquire the knowledge and skills needed to engage in inquiry learning. This continuum includes directed inquiry, guided inquiry, and full inquiry. The beginning stage is more teacher directed and the final stage is characteristic of more student self direction (Ostlund, 2007).

Directed Inquiry – This is considered the beginning stage of inquiry where the inquiry process is modeled with students. The teacher provides the question or problem to be solved as well as the materials, predictions and procedures to conduct the investigation (Ostlund, 2007).

Florida Comprehensive Assessment Test (FCAT) – Annual tests administered in Florida to students in grades 3-11. The FCAT measures student performance on benchmarks in the content areas of reading, math, writing, and science as defined by Florida's Sunshine State Standards. The science FCAT tests in four content areas: physical and chemical sciences, earth and space sciences, life and environmental sciences, and scientific thinking. (Florida Department of Education, 2007a)

Full Inquiry – This is the final stage of inquiry where students apply skills learned at the directed and guided inquiry levels. Students are encouraged to investigate scientifically oriented problems and questions independently, developing their own predictions and procedures. It is the most complex form of inquiry **(**NRC, 1996; Ostlund 2007)

Guided Inquiry – Activities are such that the teacher's role is one of facilitator versus director. This is the second level on the continuum of inquiry or the transitional stage. Students build science literacy and focus attention on learning specific science concepts, planning and considering variables, and building on inquiry skills learned at the directed inquiry stage. Students are guided through the prediction process and given suggestions for materials and procedures to be used in investigations. (NRC, 1996; Ostlund, 2007)

National Assessment of Educational Progress (NAEP) – A congressionally mandated project of the National Center for Education Statistics (NCES) within the Institute of Education Sciences of the U.S. Department of Education, established since 1969 to collect and report information about student achievement in various subject areas, including science based on national samples of school aged children in the U.S. and its territories. (NAEP, 2005)

Science Kit – A curricular program that includes ready made resources and materials designed for student use in experiments as they explore inquiry based questions.

Scientific Inquiry - Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world (NRC, 1996, p.23).

Scientific Literacy – The idea of science education for a broad and functional understanding of science (DeBoer, 2007); the ability to understand scientific concepts related to everyday experiences by being able to critically evaluate questions, thoughts, assumptions and ideas (NRC, 1996).

Sunshine State Standards (SSS)- Academic standards developed by the Florida State Board of Education which identify academic expectations for student in the state of Florida (Florida Department of Education, 2007c).

The Nation's Report Card ™ - A report published by the NAEP designed to provide information to the public about the academic achievement of students in the United States (NAEP, 2005).

Summary

In this chapter, I provided a summary of the purpose of this study, the factors that led to this particular project, its significance, rationale and limitations of the study. In Chapter Two, I provided a review of science reform efforts that support science instruction using inquiry-based methods, which has led to the development of innovative teaching materials, such as inquiry kits. In addition, I reviewed the role of teacher attitudes as related to classroom practices, changes in science instruction, and other barriers teachers face when implementing curricular reform. In

Chapter Three, I discussed my research methodology which included the design of the study, and the methods I used to collect and analyze the data. In Chapter Four, I documented the methods used to conduct the study, detailing the collection of information throughout the project, along with the results of the study. Finally, my conclusions were presented in Chapter Five, which revealed that implementing the kit based program was a process with successes and obstacles alike.

CHAPTER TWO: LITERATURE REVIEW

Introduction

Research indicates that teachers are a critical component of science reform efforts (American Association for the Advancement of Science [AAAS], 1990; Fullan, 2007; Jones & Eicka, 2007a). Most agree that top-down approaches are not successful (AAAS, 1990; Fullan, 2007; Jones & Eick, 2007b) because issues surrounding reform often deal with the perceptions, attitudes, and beliefs of individuals, namely teachers. It is the beliefs of teachers that filter classroom interactions, definitely impacting student experiences and learning in science education (Jones & Eick, 2007b). Teachers often significantly rely on the materials they use to structure learning experiences (Their, 2001). One trend in instructional materials seems to be structured around the use of a materials kit which allows teachers to incorporate more guided inquiry activities that foster student engagement. Yet, regardless of how well conceived, research-proven the materials are, "their effectiveness depends on the human interactions of the teacher" (Their, 2001, p.11). Therefore, observing teachers' interactions with instructional materials within the classroom setting, and reviewing teachers' beliefs and attitudes can help understand what occurs in science instruction, and connect reform efforts in science education. The framework for this study illustrates that teaching students using inquiry based strategies is considered an effective strategy to use in science education; however this is impacted by teachers' attitudes. In essence, using kit based instructional materials can help teachers implement science education at the elementary level more effectively.

Inquiry

Today's leading authority for how we define inquiry comes from the National Science Education Standards (NRC, 1996): "Inquiry is a multifaceted activity that involves making observations; posing questions; examining various sources of information; planning and conducting investigations using tools to gather, analyze, and interpret data; posing and exploring questions and predictions along with opportunities to discuss explanations and communicate results" (p.23). The National Science Education Standards (NRC, 1996) and the American Association for the Advancement of Science (2008) suggest that science education should be based on the use of inquiry.

Yet, this idea is not new. In 1909, John Dewey noted in a speech addressed to the American Association for the Advancement of Science that students needed to be provided with opportunities to engage in hands on experiences in science versus receiving science education teaching that focused on memorizing a series of facts. In his speech Dewey stated, "Science teaching has suffered because science has been so frequently presented just as so much ready-made knowledge, so much subject-matter of fact and law, rather than as the effective method of inquiry into any subject-matter" (Dewey, 1910, p.124). His ideas indicated that effective inquiry strengthened students' abilities to think critically and process new ideas not only in science, but in multiple disciplines. In the 1930's, an instructional model based on Dewey's philosophy became popular, which included (a) sensing a perplexing situation, (b) clarifying the problem, (c) formulating a hypothesis, (d) testing the hypothesis, (e) revising tests, and (f) acting on solutions (Bybee et al., 2006). A later model developed by Atkin and Karplus in the 1960s, used in a science curriculum improvement study (SCIS) included a three step process that used the terminology (a) exploration, (b) invention or term introduction, and (c) discovery or concept application (Bybee et al., 2006). This was the direct inspiration for the 1980's 5E Instructional Model (Bybee et al., 2006) which lends itself well to inquiry teaching as it includes the basic elements of inquiry (Everett & Moyer, 2007). Since that time, 5E model has been used in elementary, middle, and high school programs. It has five phases: engagement, exploration, explanation, elaboration, and evaluation. Everett and Moyer (2007) describe the five phases as "engage which focuses students on a question, explore where that question is investigated, explain where data from the investigation are analyzed and interpreted, extend and apply where concepts are connected to other concepts as well as to the real world, and finally, evaluate where the understandings are assessed" (p.54). The National Research Council (1996; 1999) also supports the 5E instructional model. Bybee et al. (2006) cite several studies that demonstrated that students who were taught using the 5E learning cycle had greater learning gains than students taught using traditional methods.

When students are engaged by inquiry teaching, they develop their knowledge of fundamental scientific ideas through dialogue and practice (National Science Foundation, 2000). "Children are naturally curious and eager to make sense of the world around them. In that regard, they are very much like scientists in that both search for explanations as to how things work and why things behave as they do" (Bentley, Ebert & Ebert, 2007, p. 35). Inquiry helps "enable students to construct meaning for themselves through exploring relationships and webbing those explorations to their prior knowledge" (Lowery, 1998, p. 30).

How does inquiry look in elementary classrooms? The characteristics of a classroom engaged in inquiry is one where learners are actively engaged in acquiring factual knowledge, and in formulating and asking questions that challenge and shape their understandings about the natural world (National Science Foundation, 2000; NRC 1996). Inquiry allows students to relate to the knowledge they are gaining based on their personal experiences.

Why do the standards advocate the use of inquiry teaching? One reason is that the process of inquiry helps provide students with thinking and reasoning experiences which are necessary not only in science but all facets of life (NRC, 1996). Studies indicate that a positive relationship exists between inquiry-oriented teaching and student achievement (Anderson, 2002). It is even thought that exposure to science during early childhood is critical to improved academic achievement in later years (Eshach, 2003). Furthermore, inquiry teaching is beneficial for all students, including ESOL students (Fradd & Lee, 1999), special education students, and students of poverty (Ohana, 2006) in learning and retaining content. Inquiry is also developmentally appropriate for elementary students (Bentley et al., 2007).

Amaral, Garrison, and Klentschy (2002) examined the science performance of elementary students who were English language learners, situated in an area of extreme poverty. Teachers used inquiry based kit instructional materials in science. The results indicated that there was a positive correlation between the numbers of years students were exposed to inquiry based instruction and academic achievement in science, reading, writing, and mathematics. Another study (Hampton & Rodriguez, 2001) considered the impact of science inquiry with English language learners in a bilingual classroom. This study was conducted in 62 different classrooms in schools near the Mexican border. Not only were students English language learners; but they were also socio-economically disadvantaged. Intern teachers used an inquiry based, hands-on program and found that not only was science content knowledge increased language skills in both the native language and second language also improved. Further, guided inquiry as opposed to open inquiry may be a more appropriate method to use with English language learners until language skills in English are strengthened.

Inquiry is also beneficial for students with disabilities. In a study of four school districts in four states, Scruggs, Mastropieri, Bakken, and Brigham (1993) compared the effect of teaching science using textbook versus activities-oriented teaching approaches. The study focused on students with learning disabilities. Students performed better on tested material that was learned through inquiry methods versus content learned through the textbook approach. Moreover, students preferred learning using inquiry methods and retained information for much longer. The results of this study indicate that structured inquiry methods help students with learning disabilities acquire and retain scientific concepts.

Another program that demonstrates that hands-on learning is appropriate for students with disabilities is the Science Activities for Visually Impaired (SAVI) and Science Enrichment for Learners with Physical Handicaps (SELPH) project. This was created through the work of the Lawrence Hall of Science, funded by the U.S. Department of Education. When originally designed, it was developed to help blind students access science content. When tested with various students, an unexpected benefit was discovered. The program worked effectively, not only with blind students, but with students with and without other physical and/or learning disabilities as well (Lawrence Hall of Science, 2009).

The bottom line is that “inquiry is central to science learning” (NRC, 1996, p.2) and characterizes good teaching and active learning (Anderson, 2002). While inquiry is not the only method of teaching science, it does lead to higher achievement, improved higher-order thinking skills and attitudes towards science (Ohana, 2006). The fact that scientists themselves use the principles of inquiry is more support for the fact that children should develop their scientific literacy in the same manner (Ohana, 2006). The standards (NRC, 1996) seem to advocate for the use of inquiry in science teaching because of its many benefits to student learning.

Teacher Practices, Beliefs and Attitudes

We know that teachers play a critical role in improving the effectiveness of science instruction (Yilmaz-Tuzun & Topcu, 2008). We also know that on a daily basis elementary teachers face the daunting task of implementing inquiry, whether voluntarily or by mandate, within their classrooms amongst a myriad of other challenges such as standardized testing and high stakes accountability measures. Often, the most difficult task teachers have to overcome is changing from practices with which they are comfortable (Johnson, 2006). This challenge presents itself because change is difficult and "all teachers of science have implicit and explicit beliefs about science, learning, and teaching" (NRC, 1996). That is why it is important to be able to examine and reflect upon teachers' beliefs and attitudes. In looking at what constitutes teacher attitudes and perceptions, research indicates that these beliefs are expressed in the actions and discussions of teachers (Trumbull, Scarano, & Bonney, 2006).

Several studies present a compelling argument that teachers' perceptions, attitudes and beliefs strongly influence practices in the classroom and the academic success of students (Eshach, 2003; Koballa, 1988; Roehrig & Kruse, 2005, Yilmaz-Tuzun & Topcu, 2008;). This would seem like a logical conclusion, because it may be difficult for one to practice effectively something in which they do not believe. When teaching, teachers may tend to rely upon that which is comfortable and familiar although, in theory, they might agree with the idea of teaching using inquiry. This remains one major obstacle to implementing inquiry in the classroom. Many teachers simply did not experience this kind of learning when they learned science (Bentley et al., 2007). Consequently, teachers resort to teaching science using whatever readily available materials there are which often leads to textbook teaching where material in the textbook is covered by being read, lectured on memorized, and then tested.

Trigwell, Prosser, and Waterhouse (1999) conducted a study where they found that there is a relationship between teacher conceptions towards teaching and the methods they use to teach content. Teachers who view themselves as transmitters of information or knowledge tend to focus on teacher centered strategies. “This approach is one in which the teacher adopts a teacher-focused strategy, with the intention of transmitting to the students information about the discipline. In this transmission, the focus is on facts and skills, but not on the relationships between them. The prior knowledge of students is not considered to be important and it is assumed that students do not need to be active in the teaching-learning process” (Trigwell & Prosser, 1996, p.80). In contrast, teachers who perceive teaching to be a matter of developing conceptions, tend to use a student centered approach. In this approach students are viewed as having to construct their own knowledge in order to develop their conceptions of what they are studying (Trigwell & Prosser, 1996). While this study did not specifically use the terminology “inquiry learning,” the learning experience encompasses what inquiry learning is all about. It is the student centered approach, aimed at supporting deeper student understanding and conceptualization of content that is aligned with inquiry learning. This is where students were allowed the opportunity to question ideas, challenge beliefs, and engage in discourse. Moreover, the results of this study found that not only is there a correlation between teacher conceptions towards teaching and the methods they use to teach content, there is also a relationship between teaching approaches and student learning. Their analysis suggested that when teachers used less of an information transmission model, students reported gaining more depth of learning.

Similarly, another study of middle school teachers (Johnson, 2006) revealed that "one of the problems associated with teachers' inability to change their beliefs about how science should be taught related back to how they were taught and their experiences as learners" (Johnson, 2006).

One study described teacher beliefs as "their conclusions, philosophy, tenants, or opinions about teaching and learning" (Czerniak, Lumpe, & Haney, 1999 p.125). Teacher questionnaire information revealed that most teachers were actually in favor of reform based instruction, but felt discouraged by lack of materials, lack of time, and mandated testing. Those beliefs play a powerful role in what gets implemented at the classroom level, if ignored, problems with reform efforts may arise (Czerniak et al.). A later study by this group (Haney et al., 2002) used a framework that identified two specific types of teacher beliefs: capability and context. Capability beliefs are a person's perception of their own effectiveness (Haney et al.). Context beliefs are how much support a person perceives they will receive to carry out an activity effectively (Haney et al.). According to the study, these two beliefs create a continuum of belief patterns. Using this framework, they investigated the relationship between elementary teacher beliefs about teaching science and their ability to effectively teach science. This study utilized the 1998 Horizon Research Inc. criteria as used by the National Science Foundation to document effective teaching practices in science. Teachers in the study completed a questionnaire that was used to develop what the researchers referred to as participant belief profiles. Teachers were also observed using kit based lessons that covered various scientific concepts, after which they completed an interview. In general, the study found that teachers with high capability and context beliefs were more likely to incorporate inquiry based lessons and communicate the content as presented using the kits properly, thus confirming that there is a relationship between what teachers believe and what they do in the classroom.

Roehrig and Kruse (2005) conducted a study with high school teachers in a large urban district for the purpose of understanding the impact reform based curriculum had on teachers' practices and the beliefs that confirmed this. Interviews and observations reflected that although teachers had access to and used the materials, beliefs were also a factor in whether or not the teacher actually used the materials as intended. Teachers who held traditional methods of teaching seemed to be the most resistant to change. However, overall the use of the curricula materials seemed to have positive impacts on teacher practices. Often teachers recognize the value of teaching using different approaches, and yet they still teach in ways to meet their own perceptions as was noted by Fradd & Lee's (1999) research of teachers working with English language learners.

In comparison, a few studies show that teacher attitudes do not necessarily influence classroom practices. Trumbull et al. (2006) examined the practices and conceptions of two teachers over a three year period and found that the teacher whose views were reportedly in line with reform standards did not actually practice inquiry in the classroom. Another qualitative study (Gunel, 2008) of one teacher's transition from traditional based teaching to student-centered or inquiry based teaching noted that the teacher struggled to develop his own conceptual knowledge of the material at times. This may explain why it is often easier for teachers to rely on textbook information and lecture methods without engaging in content exploration themselves. Gunel's report made an interesting note in that teacher attitudes may be, and often are, influenced by the reality of the community of teacher's and the school based administration. However, while this may be true, a study conducted as part of the National Science Foundation funded Local System Change through Teacher Enhancement (LSC) program research project (Shimkus & Banilower, 2004) which compared teachers' and principals' perceptions of the factors they felt influenced instruction suggests that the attitudes of neither teachers nor principals predicted the feelings of the other group. Nevertheless, this does not imply that teachers do not perceive barriers to implementing reform based science instruction. On the contrary, according to the information teachers reported in questionnaires collected during the project between 1997 and 2003, lack of resources was perceived to be a barrier to their instructional quality.

Instructional Materials, Importance, Support and Challenges in the Science Classroom

In addition to the availability of resources for students, teachers also need high quality instructional materials that will support a consistent presentation of scientific concepts so that they themselves can facilitate inquiry in the classroom (National Science Foundation, 2000). This helps meet the needs of both students and teachers (Eshach, 2003). Mastropierri and Scruggs (1994) found that some schools still tend to adopt textbook driven approaches even though reform efforts called for inquiry based thematic approaches. Their study compared textbook versus activities based, or inquiry instruction. They noted that textbook teaching emphasized access of content through reading and focused on factual recollection of text, vocabulary and facts. Even though textbook teaching allowed for a wide breadth of topic coverage in a short amount of time, there were little opportunities for student exploration. The activities-based instruction, which placed less emphasis on reading about science and more emphasis on hands-on experiences with topics being explored, was found to be the preferred method of teaching because students understood concepts and retained their learning. Their study confirmed that traditional textbooks alone are not conducive towards inquiry-based teaching (NRC, 2000) where students focus on memorizing facts, reading about science, and learning new vocabulary. Students often have a difficult time really understanding the relevance of scientific concepts when simply reading about science because there is very little relevant interaction, dialogue, and problem solving. Thus, there is a need for materials that teachers can use to help them teach students effectively.

One survey of elementary science materials available in Virginia in 1989 (Their, 2001) noted that of the more than twenty programs researched, only one program did not include some type of instructional materials kit. A follow-up survey conducted in 2001 found that although there were fewer companies publishing materials, all included some type of materials kit. There seems to be a trend in commercial curricula that incorporates textbook, and science kits that are geared towards including resources to engage students in inquiry learning. This is critical, because lack of materials is one factor that can impede inquiry based teaching (NRC, 2000). This demand for inquiry oriented materials may indicate a more positive attitude towards science education at the elementary level (Their, 2001).

These types of commercial kit based science programs have been adopted by many school districts as they have been revised to meet benchmark expectations that fall in line with the National Science Education Standards (Bentley et al., 2007). A key characteristic is that they are based on frameworks that actually connect big ideas, themes and concepts rather than focusing on fact memorization (Roehrig & Kruse, 2005). What's more is that these materials can provide teachers with a sequence of instruction, content support, and pedagogical strategies (Roehrig & Kruse, 2005). These types of curricular programs support guided inquiry instruction. In guided inquiry, there is support for open discussions and student questions, but the concepts and lessons are fixed (Jones & Eick, 2007b). “In guided inquiry the curriculum provides the concepts for the study, while students investigate related questions through a series of scaffolded activities where they collect and analyze data" (Jones & Eick, 2007b, p.914)

Other examples of guided inquiry kit based curricula include Full Option Science System ™ (FOSS; Lawrence Hall of Science, 2005), Science and Technology for Children ™(National Sciences Resource Center, 2003), and Biological Sciences Curriculum Study Science Tracks (BSCS, 2007). Each of these programs have been developed to meet the National Science Education Standards (NRC, 1996), and include research based content materials, comprehensive teacher guides, teacher preparation videos, online resources, and hands-on kit materials to provide students with hands-on activities that are structured, yet flexible enough to support student investigation.

It is important to note that studies conducted on the FOSS program indicate that "students learn and retain more content knowledge; students gain confidence in their ability to do science and solve problems; students improve in their language arts (reading, writing) skills; students attitudes toward science remain high; and females have as much success as males" (Lowery, 1993, p.6). Many subsequent programs have been designed based on the format and structure of the FOSS program.

Jones and Eick (2007a) conducted a case study of the obstacles, adaptations, and practical knowledge development of middle school teachers when implementing inquiry kit curriculum. The study was conducted in a rural southeastern middle school of sixth and seventh grade students with a total population of about 750 students. The school had recently adopted the teacher-centered Science and Technology for Children™ and Science and Technology Concepts for Middle School™. The kits' lesson plans included structured, pre-set topics and hands-on activities that followed a learning-cycle model. "A developed curriculum such as this in which questions and discussions over student-generated data occur, but science concepts and lessons are fixed, is referred to in this study as guided inquiry" (Jones & Eick, 2007a, p. 494). Six teachers participated in the study, which included the use of interviews and reflective journals that detailed the difficulties experienced in using the kit curriculum. Additionally, teachers were also observed by the principal investigator who used a modified protocol from the 1996 Local Systemic Change Classroom Observation Protocol. This protocol assisted with compiling information about classroom practices generally associated with exemplary inquiry based science teaching (Horizon Research, Inc. 1997). A focus group interview was conducted at the end of the study to encourage group discussion and reflection. Two teachers were selected for the final case study discussion. It was noted that both teachers were predisposed in favor of the curriculum. Teachers struggled with classroom management problems associated with managing kit materials and completing lessons within prescribed time limits. Many lessons ran over time due to in-depth discussions; however, as teachers became more comfortable with using kits, these areas improved. In terms of professional development training in the use of the kits, teachers only received two weeks. This was not a substantial amount of time and resulted in teachers only having a surface knowledge of the kit components. It should be noted that one risk of limited professional development training according to a Cronin-Jones 1991 study (as cited in Jones & Eick, 2007a) is that when teachers do not have lengthy initial training, they often make adaptations due to the challenges they face which may result in either the alteration of the curriculum due to their beliefs or the abandonment of the curriculum altogether. This content rich kit curriculum was used by teachers to support their own perceived lack of background knowledge. As a result of the use of the kit, teachers relied less on reading textbook, incorporated cooperative learning, and used journaling and questioning with students. Jones and

Eick (2007a) concluded that "implementing an excellent, inquiry-based curriculum that includes pedagogical information and content knowledge can create changes in teachers' pedagogical content knowledge and practical knowledge through practice that supports inquiry" (p. 510).

By creating materials that are well matched to teachers' learning and support needs, real instructional improvement is possible (Schneider, Krajcik, & Blumenfeld, 2005), although not guaranteed.

> Even in districts or schools where a particular science program is adopted, it is not unusual to find books or materials kits lying unopened. All too often, teachers either cannot find time to teach science or else do so sporadically, after they have complied with mounting pressures to teach the 'basic' subjects of reading, writing, and mathematics on a daily basis to prepare students for standardized tests. (Their, 2001, p.xix).

Summary

The National Science Education Standards (1996) have been a catalyst for improved science curriculum materials and has been influential in reform efforts in science. Research indicates that best practices in science instruction support inquiry based teaching in the area of science at all levels. Often, teachers find reform-based teaching to be challenging because of the need to often overcome the influence of their own attitudes and lack of inquiry based experiences (Schneider et al., 2005). Additionally, lack of resources and materials critical to maintaining ongoing investigations with students has been an even stronger barrier to implementing inquiry in the classroom. Kit based instructional materials are one way in which teachers' content knowledge and classroom management needs can be supported.

In Chapter Three of this thesis report, I provided details about the setting, instruments, data collection and analysis methods used in the study.

CHAPTER THREE: METHODS

Introduction

The purpose of this study was to observe the practices of teachers when using an inquiry based science kit program in fourth grade classrooms. In doing so, I explored the attitudes of teachers towards their preparedness to teach science with the support of a curricular program with science kit resources, and their practices when using the program.

Qualitative methods were used to collect data for this study since "qualitative research seeks to understand the world from the perspectives of those living in it" (Hatch, 2002, p.7). I obtained data from three teachers through interview, questionnaires, observations, and field notes. In this chapter I report the design of this study, the setting in which the study took place, and the data collection methods used in this research project.

Setting

This study took place in an Orange County Florida elementary school of approximately 700 students; 51% of whom were female, and 29% male. The ethnic makeup of the school included Caucasian (46%), Hispanic (29%), Asian (12%), African American (6%), Multiracial (6%), and American Indian (1%) students. The school campus housed administrative offices, a media center, cafeteria, computer labs, math lab, science lab, and reading labs. There were 44 classroom and 5 resource teachers. In addition to kindergarten through fifth grade classes, the school also had self-contained autistic units. Students were serviced in regular education and exceptional education programs. A wide range of academic programs to support learning were also available including, English for Speakers of Other Languages (ESOL), Specific Learning

Disabilities (SLD), Co-teaching, Guidance Programs, Drug Abuse Resistance Education (DARE), Pre-Kindergarten, Sheltered and Mainstreamed Autistic Support, Occupational Therapy, Physical Therapy, Adaptive Physical Education, Language Arts Resource, Strings Program, academic enrichment for Extended Day, and Speech/Language assistance. The school is considered an "A" school based on the Florida Department of Education's school scoring system, and has been for several years.

Participants

Of the school's six fourth grade teachers, three participated in this research project. Teachers who participated were given pseudonyms. Ms. Rosschire, a Caucasian female teacher had six years teaching experience at the first, second, and fourth grade levels. This was her first year in this school district. She had taught in Ohio prior to moving to Florida. In Florida, she had taught in Brevard County prior to moving to this school in Orange County. This was her first year at the school in which this study took place. She was an elementary education major, and was certified to teach Physical Education, K-12, K-8, and ESOL. Mr. Winchester, was a male, Caucasian teacher with five years teaching experience, which included one year of substitute teaching. Mr. Winchester had only taught at the fourth grade level and only for this school. He was the team leader for the school year in which the study took place. During his first two years, he completed the district's Alternative Certification Program as his educational background was not in education. Ms. Kowalski, a Caucasian female, had three years teaching experience. This was her first year teaching fourth grade. She had previously taught at the second grade level. She was an elementary education major and was certified to teach K-6. She had been in the district for three years. When I shared the purpose of my action research with each teacher participant, each expressed an interest to engage in professional collaboration so that they could utilize the district adopted program and resource materials and work together to implement best practices in the classroom. They were willing to satisfy the requirements of completing surveys, being observed, and conducting follow up discussions during the school year. The participants were open to participating in the research and using the district adopted materials during science teaching. Moreover, they expressed the desire to learn more about themselves through action research.

Instruments and Data Collection Methods

Observations, field notes, interviews, and questionnaires are characteristic of action research based, qualitative studies (Hatch, 2002). Teachers were given a survey at the beginning of the study. The survey was a modified version of Horizon Research, Inc.'s Local Systemic Change through Teacher Enhancement Science K-8 Teacher Questionnaire instrument (Horizon Research Inc., 2003). This questionnaire was designed originally to obtain information from teachers about their "opinions, their preparation, their teaching practice, and the quality and impacts of their professional development experiences (Horizon Research, Inc. 2000). The purpose of this instrument in this study was to gain insight into teachers' opinions and teaching practices in science. This survey was repeated again at the end of the study, along with a focus group discussion, to determine if there were any changes to teacher opinions as a result of using the science kits.

Classroom observations of teachers' science instruction occurred during the school year, in November, April and May. "Observing participants in action provides avenues into their understandings that are unavailable any other way" (Hatch, 2002, p.90). Observations lasted from thirty to forty-five minutes, and did not involve any identifying information related to the students. The intent of the observations was to observe how teachers used the kit based materials in the classroom. Each teacher was observed three times during the study.

Field notes, which were anecdotal in nature, were taken during each observation session. The initial plan was that each session would be audio taped, however the researcher found that teachers were initially uncomfortable with being audio taped. After the first two observations and discussions, teachers were more comfortable with the researcher observing in class. Thus, the last observation session for each teacher was audio taped. This allowed the researcher to collect more in depth information during the observation process.

A final focus group session to discuss the teachers' collective experiences with using the inquiry based science kit program was held at the end of the study. The focus group interview was guided by explicit questions (see Appendix E) as well as items which the researcher collected during observations or from the questionnaires that warranted further discussion . It is common to follow up observations with an interview in order to get another take on teacher perspectives rather than solely relying on the use of the researcher's observations alone (Hatch, 2002). Although I used guiding questions in this group interview session (see Appendix E), this was an informal interview with free flowing, group dialogue.

Data Collection

After submitting and receiving IRB approval from Orange County Public Schools (Appendix A) and the University of Central Florida (Appendix B) in November, 2007, I met with the participants to review the parameters of the study and provided consent letters (Appendix C) for their review. When I received the signed consent forms, I created pseudonyms for each participant to maintain teacher confidentiality. The pre and post questionnaires (Appendix D) and observation/field notes were maintained in a locked cabinet. Files created on the researcher's personal computer and jump drive were password protected. Audio tapes were maintained until transcribed and analyzed, and then were destroyed by the principal investigator as per the parameters of the participant consent form.

After obtaining IRB approval, teachers completed their pre-survey questionnaires in November, 2007, and responded to the same questions at the end of the study in May 2008 (Appendix D). This survey was based on a modified version of the Horizon Research, Inc. Local Systemic Change through Teacher Enhancement Sciences Grades K-8 Teacher Questionnaire. The questions were categorized into two areas. The first area asked questions about the teacher's opinions towards science teaching and their perceptions of their preparedness to teach science. The next section asked questions about science teaching. Questions were either closed ended or based on a Likert-based scale, commonly used in questionnaires, where participants evaluate the degree in which they agree or disagree with statements.

Initially, we planned an observation schedule that would allow for weekly observations in one of each of the classrooms. After the initial round of observations, a revision to our original schedule was required when we realized that weekly lessons did not allow the teachers sufficient time to plan and organize lessons using the kit materials. We then planned bi-weekly observation sessions, but needed to make another adjustment when we learned that the school had been randomly chosen to participate in the Florida Writes field test. This, along with other items such as the school holiday calendar (Thanksgiving and Winter Breaks), workshops, school-based testing, and district required benchmark testing forced us to place the observation schedule on hold until after the Florida Comprehensive Achievement Test (FCAT) had been administered. In the meantime, teachers continued to plan lessons as a team.

In April and May, 2008, the observation schedule began again, and two additional observation sessions were completed with each teacher. Since the team planned together and maintained similar lesson schedules, this schedule actually allowed me to observe the interaction of each teacher teaching the same lesson. During each observation session, I sat in the back of the classroom so as to not interrupt normal classroom interactions and took anecdotal field notes to document the experience. Student identifying information was not collected as the intent of the observations was to observe and document teacher practices. To provide a structure and focus for my observation and note taking, I referred to the Inside the Classroom Observation and Analytic Protocol (Horizon Research, Inc., 2000) so that I might hone in on practices generally associated with effective inquiry based science teaching (Horizon Research, Inc., 2000).

In early June, 2008, we conducted a focus group session to discuss the teacher experiences using the kit materials. This session was led using scripted open-ended questions to guide dialogue (Appendix E), however this was a flexible session with shared conversation. In this session, it appeared that teachers were very comfortable discussing their struggles and strengths amongst each other.

Data Analysis

The purpose of this study was to study teacher practices and attitudes regarding their preparedness to teach science using a program with inquiry kit materials. Specifically, I wanted to discover more information about fourth grade teachers' attitudes towards teaching science using inquiry based strategies and see how teachers used a curricular program with science kit resources in the classroom. By collecting data from multiple data perspectives, triangulation was accomplished.

I collected the initial survey from each of the teachers and reviewed the information contained within each survey. I tallied the responses to each question in a combined format to see if there were any trends or common responses when the responses were aggregated. I also looked for responses that varied and spoke with individual participants to ask further clarifying questions as to what influenced such responses. I analyzed the combined responses to each section of the pre survey to determine if there were overall trends within the data collected.

This was followed by teacher observations. Observations were used as a means to verify instances of teacher practices that either supported or contradicted reported beliefs. For each lesson, I observed the classroom environment and the noted the materials being used by the teacher as well as the manner in which the teacher used the kit materials. I summarized and compiled my notes from each of the three observations session.

After the final observation, I asked teachers to complete the post survey forms, bearing in mind their experiences with using the kit resources and collaborating as a team. Teachers completed their post survey forms individually and submitted them to me. I examined the data from the final surveys to the initial survey responses and compared this information with data collected through observations and/or our focus group dialogue to determine any contributing factors for such trends.

I used the final focus group session to review the data I had collected and discuss teacher overall attitudes, and discuss observed practices and contributing attitudes together, asking particular questions about how the kit supported instructional practices. Data collected across data methods were analyzed to determine any recurring themes or patterns connected with beliefs or practices as related to the use of the science kit resources.

Summary

In Chapter Three, I discussed the design of my study, detailing the setting in which the study took place, and documented instrument selection, data collection, and analysis methods. In Chapter Four, I further documented my research project by presenting the data collected to support my findings.

CHAPTER FOUR: DATA ANALYSIS

Introduction

The purpose of this study was to examine teachers' practices in using an inquiry based science kit program in fourth grade classrooms. I collected data on the science instructional practices of three elementary teachers through the use of observation notes, pre/post surveys, and focus group notes.

Teacher Preparedness to Teach Science

My first research question was: How well prepared did teachers feel when using a curricular program with inquiry kit materials to teach science as inquiry? To determine what teachers felt towards their preparedness to teach science, I asked the teachers to complete a pre-survey at the beginning of the school year. Teachers also completed the survey at the end of the year, after using the inquiry kits. I compared trends and differences between their answers to determine changes or patterns among their responses.

Each teacher was asked to rate how well prepared they felt to teach science, math, reading/language arts, and social studies at the fourth grade level. They were asked to report whether they felt very well prepared, fairly well prepared, somewhat prepared, or not adequately prepared in each subject area. According to the initial survey, Ms. Rosschire reported feeling fairly well prepared to teach science and social studies and very well prepared in reading/language arts and math. Mr. Winchester reported feeling not adequately prepared to teach science, somewhat prepared to teach social studies, and fairly well prepared to teach reading/language arts and math. Ms. Kowalski reported feeling fairly well prepared to teach science and social studies, and very well prepared to teach reading/language arts and mathematics. Their collective responses indicate that they all felt better prepared to teach reading/language arts and math compared to science and social studies.

When comparing their pre-survey responses to their post survey responses, each of the three teachers reported positive changes in their preparedness to teach science. I wondered if this might have been attributable to teachers simply acquiring another year's of experience in the grade level with the content material, and posed this question to the teachers during the focus group discussion. Teachers agreed that they felt more prepared to teach the content because of the kit resources. When asked to describe their attitude towards using the kit to support inquiry based science instruction, their responses were:

> Ms. Rosschire: "I enjoy using inquiry based instruction and the kits in my classroom because it encourages students to relate science to their daily lives. I didn't do it as much before I really began using the materials."
>
> Mr. Winchester: "The kit really is a godsend."
>
> Ms. Kowalski: "Well, I feel that it (the kit) is very needed in the classroom since students need the most structure possible and this (the kit) supports that very much."

Within content areas, teachers often feel more prepared to teach specific topics. Therefore, another question asked of teachers on the survey was how well prepared they felt to teach the following science topics at the fourth grade level: the human body; ecology, rocks & soils, astronomy, processes of change over time (evolution), mixtures & solutions, electricity, sound, forces & motion, machines, and engineering & design principles (e.g. structures and models). Ms. Rosschire reported feeling very well prepared to teach the human body and fairly well prepared to teach all the other topics. When I asked about this, Ms. Rosschire noted that her physical education certification provided her with additional content expertise and thus, she felt comfortably prepared in this area. At the end of the study, this teacher felt very well prepared to teach two additional topics (rocks & soils and forces & motion).

Mr. Winchester reported feeling somewhat prepared to teach six of the eleven content areas and not adequately prepared to teach processes of change over time (evolution), mixtures & solutions, sound, forces & motion, and engineering & design principles. At the end of the study, this participant's attitudinal change was positive in each of the eleven content areas, with a final report of feeling fairly well prepared in each of the eleven areas.

Ms. Kowalski felt fairly well prepared to teach two areas (sound and forces & motion), somewhat prepared to teach five areas, and not adequately prepared to teach ecology, astronomy, machines, and engineering & design principles. When the participant was asked what helped to make her feel fairly well prepared in the two areas reported, the participant noted that a part-time job with a local company in a science lab environment working with children in these areas aided in the ability to have repeated hands-on practice and interaction with this specific content. At the end of the study, there was a positive attitudinal change in five areas and no attitudinal change in six areas.

There did not seem to be a trend with regards to content areas teachers were less comfortable teaching at the beginning of the study. It did seem, however that where teachers had received additional experiences outside the normal teaching routine they felt more comfortable with the specific subject content. When I compared teacher responses from the pre and post surveys to see if there were changes in attitudinal responses, there was an overall positive shift in teacher responses. In May, the total areas where teachers felt not adequately or somewhat prepared to teach decreased significantly.

One section of the survey asked teachers how prepared they felt to (1) lead a class of students using investigative strategies; (2) manage a class of students engaged in hands-on/project based work; (3) help students take responsibility for their own learning; (4) use strategies that specifically encouraged participation of females and minorities in science; (5) involve parents in the science instruction of their students; and (6) recognize and respond to student diversity. Teacher response options were not adequately prepared, somewhat prepared, fairly well prepared, and very well prepared. On the initial survey, the teachers all responded that they felt somewhat prepared. However, on the final survey, the teachers' responses in each area indicated positive attitude changes. In every area, their perception of their preparedness changed to feeling fairly well prepared or very well prepared in all areas.

Teachers were asked to rate the importance of twelve instructional practices in science instruction. These were: (1) provide concrete experience before abstract concepts, (2) develop students' conceptual understanding of science, (3) take students' prior understanding into account when planning instruction, (4) make connections between science and other disciplines, (5) have students work in cooperative learning groups, (6) have students participate in appropriate hands-on activities, (7) engage students in inquiry oriented activities, (8) use computers, (9) engage students in applications of science in a variety of contexts, (10) use performance-based assessment, (11) use portfolios, and (12) use information questioning to assess student understanding.

When comparing responses from the end of the study to the beginning of the study, in most of the responses, teachers had either no attitudinal change or a positive attitudinal change. Ms. Rosschire's responses was the same for all questions. She felt that each strategy listed was very important. Mr. Winchester's responses from the initial survey to the ending survey indicated a positive shift in importance in nine out of the twelve strategies with no change in attitude on three strategies. Ms. Kowalski reported a positive shift in three out of the twelve questions, and no change in the remaining nine. When comparing pre and post surveys, there was no negative change in attitude when teachers categorized the importance of the listed instructional strategies. I wondered if the program contributed to this, and the teachers weren't sure. We concluded that the overall experience of practicing the teaching craft, reflecting on our practices, and trying to help students learn has some influence on feelings of importance. I got the sense that participating in this study allowed us all to begin to develop our own experiences with the practice of inquiry as a process.

Teachers were also asked to rate their feeling of preparedness to teach each of these instructional strategies. One trend in teacher responses was that all of the teachers reported feeling less prepared to use computers in science instruction at the end of the study. When I probed the teachers for an explanation, they acknowledged that the inquiry kit resources included a variety of computer based tools that students could use to support their learning, but teachers found this feature difficult to implement in the classroom as there were never sufficient computers for each student. Since this study was not structured in such as way as to observe teacher practices in a situation where there were sufficient computers, I could not address whether there would be any changes to teacher practices given the additional tools they perceive to need. The teachers readily recognized there was a need to incorporate more student use of computers during instruction because in most instances, technology use was limited to teacher use when facilitating lessons. While the online tools would allow for differentiated instruction, teachers expressed a concern about managing the different levels of students and the lack of computers for all students. Furthermore, they voiced frustration at not having time to implement all the activities they desired.

The post survey results reflected that the teachers felt very well prepared to teach, at most, four of the twelve strategies in fourth grade science. Two common practices they reported feeling very well prepared to use in science instruction were: (1) engaging students in inquiry oriented activities and (2) using informal questioning to assess student understanding. When discussing science instructional practices in the focus group, they agreed that the inquiry kit resources definitely helped support them in this area. One comment made by Ms. Rosschire illustrated this point.

> Ms. Rosschire: "Using the kits, I always know we're engaging in an inquiry activity to support the (Sunshine State Standards) benchmarks. I've become more comfortable leading in the directed and guided inquiry activities, but I have to admit I'm not as comfortable with the full inquiry. Not in the sense that we can't do it. It just seems like it takes more time that we just can never seem to find. Maybe next year we can work together to figure out how to incorporate one of the full inquiry projects and see how that goes. I know it can only help prep students for fifth grade."

Based on the data collected, teachers seem to be less prepared to teach science as they are other content areas. However, the teachers perceived that they were better prepared to teach science with the support of the science kit materials because they had resources to conduct hands-on activities with students. The structure of the guided inquiry lessons provided the teachers with a roadmap to help guide student learning and gave them more comfort level with the content knowledge needed to facilitate specific guided inquiry activities.

Teacher use of Inquiry Kit Resources in the Classroom

My second research question was: How did teachers use the curricular program with inquiry kit resources in the classroom? Along with the customary textbook and workbook resources available in traditional curricular programs, the program used at the school included an inquiry activity materials kit with items for each activity organized within plastic bins, each activity in resealable plastic bags. An activity DVD provided teachers with a demonstration of each experiment. This was designed to allow teachers to preview the activities prior to use with students. Colorful vocabulary cards accompany each unit, as well as a variety of color transparencies. The school also purchased the student and teacher access to the online resource materials. The student version, which required teacher setup, included access to the textbook online. Teachers also had the capability to create and assign ancillary activities to support each lesson, such as games, videos, and assessments.

According to the initial survey responses, two of the three teachers had mixed feelings about the quality of the instructional materials. However, on the post survey, all three teachers noted that the quality of the materials used at the school encouraged effective instruction. In my observation notes, it seems that teachers relied heavily on the program. In each of the lessons I observed, the program materials were used exclusively within the classroom. Teachers responded that the inquiry kit improved their ability to implement high quality instructional materials and their science content knowledge. When discussing how the inquiry kit supported teacher's science instruction, teachers' stated the following:

> Ms. Kowalski: "It helped provide hands-on materials for every student to use. I didn't find it to be a hindrance at all; in fact the opposite. The kits helped me do more modeling and demonstrating. Once I got the hang of all the pieces and parts, I was able to manage

the resources well. But I still felt a little weak with doing student-led inquiries. I'm not sure I feel super comfortable with that yet. But what I do like is that it has the directed and guided inquiry activities, and the kids love it!"

Mr. Winchester: "I agree. I thought the kits were great and easy to follow. For me, it alleviated some of the pressure of me feeling like I didn't know all the content. The (teacher's) guide gave tips about student misconceptions and I felt that prepared me a little more to respond to questions. That helped me relax and focus on bringing the subject to life, relating it to real life. My students were excited whenever we brought out any materials, even though I did more demonstrations than anything else. Next year, I want to be sure to use more consistently."

Ms. Kowalski: "Me, too. I really want to see us use more inquiry based science lessons throughout the full school year instead of just more heavily at the end of the year.

Ms. Rosschire: "Well, we manage to fit it all in, but the timing of some of the testing puts us in a crunch. I did feel like we had more flexibility during the last half of the year when FCAT testing is over. When we do have more time, the kits are perfect because they're perfectly aligned with the text and DVD. I thought that the kits gave us a really good starting point for implementing standards based ideas. It made the task less daunting."

Another method I used to investigate teacher use of the kit materials in the classroom was through lesson observations. Through my observations, I saw an increase in the use of the program's resources among the teachers. However, the use of the inquiry kit materials did not always lead to the facilitation of hands-on, inquiry oriented lessons in science in every lesson.

In my initial observation of Mr. Winchester, the teacher used the textbook to lead the thirty minute lesson. The classroom was arranged in a U-shaped formation facing the front of the room where the board was. He circulated around the room as the students partook in reading portions of the text using the microphone. Mr. Winchester would stop the reading at various points and probe the students. Questions posed by Mr. Winchester to the students were those listed in the teacher's guide, some of which were open ended questions that required students to explain their thinking. He responded to students by asking additional probing questions. It appears as if the students were already familiar with the key terms of the unit as the teacher made several references to prior knowledge of terms such as precipitation, evaporation, and the water cycle. There was a high level of student engagement in the discussion as Mr. Winchester allowed students to share stories that illustrated various times they had participated in different weather events. He also shared his own story about his experiences during one of Florida's busy hurricane seasons, and how the wind howled, and how water filled his yard almost up to his back door. Students shared similar stories of different storms they had experienced, including snow storms. Students were assigned the task of creating an illustration that depicted the parts of the water cycle as independent work at their desks. Two other tasks were assigned to student in different centers. The first task was a file folder activity where students used the kits vocabulary cards in a matching game. In addition, students were to choose five words to add to their personal word bank journals. The vocabulary cards were made of cardstock, approximately 5" by 7". They seemed to be sturdy enough to be handled often. Each card contained vivid, colorful pictures on one side and text explaining the word meaning on the other. Similar pictures were in the textbook. They worked in pairs for this task. The next task was a writing task. Students had to write a story related to any aspect of the water cycle. While students worked independently around the room, the teacher took a small group to a kidney table located at the rear of the room and held a small guided reading group session. There, the group read a reading book, which included the same content of the textbook, but was leveled to three different reading levels: below, on, or above.

During the next observation session, Mr. Winchester began the lesson with a discussion with students. This time, he used the vocabulary cards a little differently. During this lesson, Mr. Winchester allowed each student to be the classroom "expert" on their assigned vocabulary word. When various vocabulary words were read within the text material, students would stand and explain their word meaning, share the photo provided with the instructional kit, and give details about the word within the context of the concept being discussed. Some students provided additional photos they had selected outside of the classroom independently. Mr. Winchester facilitated the classroom discussion and related the topic of discussion not only to the current topic being discussed, but also built upon prior concepts learned. There were also two instances where Mr. Winchester noted vocabulary that would be discussed further in an upcoming lesson.

On the third observation, Mr. Winchester used the teacher demonstration kit to provide a classroom demonstration to support the lesson. The lesson was a guided inquiry investigation which sought to answer the question, "How can you change the properties of glue?" It was the fourth lesson and final lesson in a series on the properties of matter. The purpose of this lesson was to help students understand that a new substance could be formed by chemically combining two substances. At various points, the teacher stopped to allow students to comment on what was occurring during the teacher demonstration. Student interest and excitement was apparent throughout the room as all were either standing or seated on the edge of their seats with eyes and attention focused on the teacher.

When I asked the teacher why he chose to do a teacher demonstration rather than allowing the students to conduct the experiment in groups, he noted that time was a factor. He had initially planned on having the children explore in groups of four, but the week's schedule prohibited this. He still wanted students to benefit from visually seeing the change, and it was easier to set up, clean up, and move on to the next activity when faced with such limited time. He was also unsure of having the students work with the borax solution and found that, in the end, he felt more comfortable doing the demonstration. He commented, "I enjoy the lively discussions in class, but so far I've been more comfortable with doing the demonstrations and dialoguing with my students. "

I was only able to observe Ms. Kowalski two times. My first observation was of a lesson on the water cycle. Students were arranged at four tables, two in groups of six, and two in groups of five. Ms. Kowalski led the students in completing a classroom K-W-L chart to document what they knew about the water cycle and what they know about the water cycle. She directed students to use their textbooks to observe pictures of each of the words and they predicted the meaning of the terms water cycle, thermometer, meteorologist, barometer, evaporation, condensation, precipitation, humidity, temperature, and wind vane. Ms. Kowalski had prepared sentence strips of the chapter's vocabulary words in a pocket chart. Each vocabulary word was discussed in terms of how it was related to the water cycle or weather. As each word was discussed, students were directed to look at the illustration in their text books. As they went through the list, the inquiry kit's vocabulary cards were also placed in the pocket chart next to the word. Next, the students read along silently while a tape of the three page text was played.

At the end of the reading, students worked at their tables to sort their words into three categories and answered the three questions at the end of the chapter. Students could help each other complete the questions, but each student had to submit an individual response. These activities were more teacher-directed, although student input through discussion was evident throughout the lesson.

During my next observation visit, students were exploring the question how can you change the properties of glue? This time, students were arranged in groups of four, with the exception of one table which was arranged in a group of six, but the arrangement allowed students to work in pairs. Each table was set up with the blue activity tray that included colorful instructions of the guided inquiry activity, all components of the inquiry kit as well as materials for each pair of students to conduct the experiment. The children's excitement was almost magnetic. Initially there was a lot of chatter. One student even squealed out and even sat on her hands to contain herself. Ms. Kowalski held up her hand and gave a "give me five" signal to which the students responded by giving her their attention. She asked, "What do you think will happen when we add all these things together?" Students offered different explanations. Ms. Kowalski asked them if they had ever seen or helped mix up cake batter. Many of the students had. She also asked them to explain how cake differed from the batter mix. One student offered that the cake tasted much better, which made the teacher and students laugh. Ms. Kowalski replied, "Some people like the batter best of all, but I agree with you. I much prefer the cake itself!"

On the projector screen, Ms. Kowalski revealed a picture of the day's exploration activity, which was the same as the picture on their activity mat. She advised the students that they would be doing something very similar to cake batter and cake. She directed their attention to the projector where she previewed the investigation question, followed by a review of each step of the activity, which was directed by the teacher. As Ms. Kowalski conducted an inventory of each of the materials with students, she held up each item for the class to see as she explained each of the six steps. She emphasized several times that the students would be observing what happened and recording their observations. Students were allowed to begin the inquiry activity, while the teacher circulated around the room. Ms. Kowalski moved to each group and encouraged the students to play with the new mixture they created and "Observe. Observe. Observe."

After almost twenty minutes, Ms. Kowalski gave the "give me five" signal again to get the attention of the students. She had each group place their new substance on the tray, and instructed the students to complete their data sheet. She explained that the data sheet was a way for them to write down what they saw, or their observations on paper. She also noted that "good scientists take detailed notes so other people can learn from them." Students were then allowed some time to take notes about the color, smell, and texture of the glue they started with and the substance they created. At this point, it was time for the class to leave and go to their special area class, and the teacher ended the session by stating, "Students, I want you to think about the new substances you created. When we return from music, we'll talk about whether or not your new substances would make a good glue or not. We'll also compare and contrast the glue and our new substance." The class lined up and went to music class.

When discussing the lesson with the teacher a few days later, she noted feeling that the lesson went well, but she also felt that the lesson took a little more time than original anticipated. She shared with me a class Venn diagram where the students came up with similarities and differences between the glue and the new substance. This was the reading skill that accompanied the science lesson. In response to the question of whether or not the substance would make a good glue or not, student explanations showed that some students thought the new substance would make a good glue since it was made out of glue, while others didn't think it would make a good glue because of the other items added to it. She commented that when reviewing the comments on the activity sheets, students had difficulty explaining their reasoning. So, she had to change the next day's lesson to include a review of the properties of solids, liquids, and gases so that the children could talk this through further.

While I did not have the opportunity to review this subsequent lesson, the teacher informed me that the students came to the conclusion that the new substance would not make good glue because it wasn't sticky like glue. They had tested it out in the class with the teacher who felt, "It was a great lesson for the kids. I'd never seen them so engaged. But it did take longer than I thought. I wish I could do it with every lesson, but there just isn't always time. But we had fun and I think they learned a lot. They seemed to grasp the concepts and really retain them later." One of the comments she made in our final session was, "I noticed that the science investigations helped out in other subject areas, too. The one experiment we did that you observed helped out with their reading skill with compare and contrast. I'd hear them over and over again talking to each other about the time we made the silly putty stuff compared and contrasted it to glue. They never forgot."

Perhaps the greatest growth in teacher use of the materials was with Ms. Rosschire. Much like Mr. Winchester and Ms. Kowalski, Ms. Rosschire's first observation reflected the teacher's use of primarily the textbook and worksheets. However, the teacher did project the colorful lesson transparencies which came with the kit on the projector screen and discussed those with students. On the second observation of Ms. Rosschire, the students were completing a guided inquiry investigation exploring the question: How can you grow a potato plant without a seed? She led a discussion with students about what they knew about growing plants and whether any of them knew what having a “green thumb” meant. Ms. Rosschire related this to the student’s knowledge of similes and metaphors and explained that it didn’t actually mean your thumb was the color green. She then had the students discuss ways they could grow a plant, and when no one offered the explanation that a plant could grow without a seed, she inquired, “Do you think it’s possible to grow a plant without a seed?” Some students said no and others said yes. One student even commented that it could be done, but that it would be a miracle and miracles can’t be explained. Ms. Rosschire acknowledged that this may be true, but that “….for some things, we just haven’t explored them yet to find out. Today we’ll investigate whether you can grow a potato plant without a seed? Has anybody ever seen someone grow a plant by putting a piece of it in water or a special kind of dirt called potting soil?” Some students raised their hand indicating they had.

Ms. Rosschire noted that the class would investigate how to grow a potato without a seed. She presented the materials, which was a cut piece of potato, toothpicks and cup with water. She pushed the toothpicks into the potato and placed the cut side of the potato in the water; the toothpicks held it in place. She instructed the students that they were going to observe what happened to the potato over the next two weeks as they studied the unit on plants. Together, they completed a classroom observation chart describing the state of the potato as it appeared to them that day. She noted that they would repeat this process in one week and then again in two weeks. She next played a clip from the lesson. It was a “You Are There” piece of less than a minute that painted a picture of flowers everywhere of different varieties growing. Music and the sounds of nature accompanied the narrator. After this, the teacher posted a colorful diagram of a plant and plant parts on the projector screen and discussed each, while students labeled their own plant parts worksheet. Throughout the lesson, students raised their hand and participated, using their books as a resource to help them respond to the teacher questions. The final product was a worksheet which mirrored the teacher worksheet Students completed their individual diagram worksheets which matched that of the teacher on the overhead. It was difficult to ascertain whether or not the students made any connections between the plant diagram and the potato or other plants as the lesson ended when the class had identified the names of the parts of the plant.

On Ms. Rosschire's final observation, she conducted a lesson on the properties of matter. Students were arranged in a U-shaped configuration. The teacher circulated around the room within the U. When I arrived, she was already a few minutes into the lesson, but I picked up where she was introducing terminology. She passed around one of the kit's vocabulary cards with the term and definition of a physical change. She noted that this one was "really cool" and that she wanted them to "take a good look at it" when it came around. She stated the definition of a physical change by saying, "A physical change is a change in size, shape, or state of matter. So let's look at this, "If I, Ms. Rosschire puts on 100 pounds, am I gonna look different?" Students audibly and visibly responded affirmatively by saying, 'Yes" and/or nodding their heads. One student even exclaimed, "Wo-oh" and looked in disbelief. The teacher noted that this would be an example of a physical change and that she would "physically look different." At this point, the teacher paused and allowed a student "expert" to explain what a physical change was and reminded them to state this using their "own words." It appears as if several students had been pre-selected to explain various terminologies in their own words upon teacher direction as she repeated this several times throughout the lesson. She paused to ask the students if "that makes sense" after this and each example presented by both the teacher and students.

She allowed students to comment and encouraged questions among the students. Then, she moved on to a chemical change in the same manner. After this, she flipped through several of the kit's vocabulary cards that accompanied the unit's lesson. She commented that they would keep those handy, along with three books they would be reading, which had more information about the unit. She stated the names of each of the three books they'd be reading in small groups. These were the leveled readers included in the kit that accompanied the unit. She also advised the children that one of the books had an interesting title that she was sure they'd all enjoy as it was one of her favorites.

Next, Ms. Rosschire stated, "But the biggest focus today's is on a 'D' word. Who remembers what that D word might be? Several students offered suggestions and she confirmed that it was density. "What is density, who can put it in their own words?" We're going to be dealing with density today by putting different objects inside and we'll see which objects will sink and which will float. Does anyone have a prediction on what they think will happen?"

When none of the students offered a response, Ms. Rosschire prompted them further, by asking them what they thought would happen if they put a crayon inside a container that she had full of water. She asked students to raise their hand if they thought it would float, sink all the way or just sink a little bit. She explained that this was what they would be experimenting with today. She noted that since they were "stuck" on making their predictions and were not really sure yet, they'd begin by watching a portion of the activity.

Next, she turned down the lights as well as the projector screen. She began a DVD. I realized that it was the teacher activity DVD that accompanied the kit materials. The screen indicated that they would be looking at a directed inquiry activity. She directed a student to read the EXPLORE question, which was: What properties cause liquids to form layers? She also stated, "That's the million dollar question!"

Then, the class watched as the activity DVD provided an explanation and demonstration of the experiment. After the first and second steps (pouring the different liquids in layers and observing them), she paused the DVD and questioned the students. "What did you notice? Remember what the million dollar question." Students commented and she provided specific academic praise regarding the comments from students who noted that some liquids sank and other floated to the top. A pattern I found in Ms. Rosschire's questioning technique during the lesson was that she used the following questions whenever a student shared a comment with the class: (a) Why do you think that would that happen? (b) How? and (c) Might there be other reasons? This seemed to foster dialogue among the students and encourage students to explain their thinking or rationale for comments contributed during the discussion.

After this, Ms. Rosschire stopped the video, indicating she didn't want to "give away" everything and asked students if they could make predictions about the different objects and whether they would float or sink when placed into the liquid. She reminded students that they would need to pay close attention as she would need several helpers to assist her before they tried the experiment on their own. Together, they made predictions about whether a paper clip, Styrofoam, or cork would float or sink. She would not confirm or deny, instead she told the students, "We'll have to see if that's true." Some students were not sure what cork was, so she had them discuss and share several examples. She directed students' attention to a bulletin board in the classroom which was made of cork material. Several students inspected and touched the material.

She demonstrated the process of adding the different liquids (corn syrup, dishwashing liquid, water with food coloring, and corn oil). For each item added, she had a student helper assist with the measuring and adding of the liquids. In actuality, students completed the entire demonstration as she simply guided the student helpers through each step. The teacher was very careful in making sure the students could measure appropriately. When the corn syrup was added, she asked students about the properties of cornstarch and how it felt to pour. When the oil was added, she asked students if they had cooked with oil. When the dishwashing liquid was added, she asked whether any of the students had to wash dishes at home. She also asked questions like: "What do you think is going to happen. Her enthusiasm was infectious as she reminded students that good experiments had steps to follow and it was important to follow instructions appropriately. As she demonstrated the experiment, she constantly oriented the students to what she was doing and reminded them that they would also be doing their own so it was important to pay attention.

At one point, she directed the students to their textbooks, calling their attention to the page number where they could follow along in their textbooks. She asked students to "make some observations" calling their attention to the placement of the different substances.

After they had tested the materials together, students were given their own materials, along with a lab sheet to note their findings. They were directed to find out on their own which liquid had highest density of all the liquids, which had the lightest, and which objects would sink or float. Students also had to explain their thinking and describe how they would be able to tell which objects would sink or float. Before students began, she allowed them to make suggestions about other small objects around the classroom they could test. The students came up with rubber bands, crayons, erasers, and broken toothpicks. This continued for the rest of the lesson, until they had to leave for their special area class.

In discussing the wrap up of the lesson with the teacher, she noted that students were able to compare their predictions and observations, and together, they discussed and explained the differences between the two. Students were also able to explain that the objects with the highest density as those which would sink versus those with the lowest density as those which would float.

I asked her how often the students strictly read from the textbook. She seemed surprised to note that she probably relied less on the textbook reading and worksheets and more on the materials in the kit, however every lesson did not include an investigation experiment. She felt that one of the best features of the kit was the way the assessment guide helped you prompt students to explain what they are thinking.

There were times, she noted, where students were required to read and complete worksheets, but she always tried to supplement with hands on or visual support, and incorporate as many inquiry investigations as time would allow. There were times when she used the level readers in a guided reading group to review content and supplement with cooperative learning activities and/or video resources. The one area she had not yet explored was the technological resources that accompanied the kit. She felt that this could really help differentiate instruction, but it would be something to delve into further next year. Like the other teachers, she felt that there was much more flexibility after the FCAT to spend more time exploring topics, and that given the amount of material required to be covered, a “healthy balance” between traditional and inquiry teaching was required. She said she wanted to do a better job of responding to student comments in journals as more of a common practice.

One section of the survey asked teachers how often they conducted specific inquiry oriented strategies in their science instruction as the teacher. I found it interesting that the teachers reported conducting the targeted activities often (once or twice a week) or all/nearly all science lessons in their pre surveys. They reported conducting this in all/nearly all science lessons in their post surveys. I decided to record which activities teachers practiced at least once during my eight observations to see if their perceptions of their practice matched their actual practices. Based on their responses, I expected to see each strategy on more than half the observations. The table below summarizes the percentage of the observation sessions in which I observed each of the listed practices being used by teachers.

Table 1: *Teacher Use of Inquiry-Oriented Strategies in Science Instruction within the Classroom*

Inquiry-Oriented Strategy	Percent of Sessions Teachers Demonstrated Strategy
Use designated program instructional materials as the basis for science lessons	100%
Introduce concepts through formal presentations	100%
Demonstrate a science-related principle or phenomenon	75%
Teaching science using real-world contexts	75%
Arrange seating to facilitate student discussion	38%
Use open-ended questions	100%
Require students to supply evidence to support their claims	63%
Encourage students to explain concepts to one another	50%
Encourage students to consider alternative explanations	50%
Allow students to work at their own pace	25%
Help students see connections between science and other disciplines	63%
Use assessment to find out what students know before or during a unit	50%
Embed assessment in regular class activities	25%
Assign science homework	0%
Incorporate student notebooks or journals where they can read and comment	0%

Based on this data, there were discrepancies between what teachers perceive are practices they implement in science instruction and practices that were actually conducted in the classroom. Nevertheless, I recognize that this information was collected based on a small sample size and a limited number of observation sessions. Results might differ for a larger sample size.

I was particularly surprised that I did not see evidence of teachers assigning homework or incorporating student notebook or journals. I expected that, at the fourth grade level, teachers would emphasize writing in science because students are tested in writing on the FCAT at this level. One set of worksheets included in the kits were especially geared towards having students reflect about their activities and provide students with the opportunity to see how writing is connected with other disciplines. Whereas the science kit included materials that could easily be incorporated into student journals, I could see how the sheer number of workbook resources could be overwhelming as the kit included a vocabulary workbook, an FCAT practice workbook, a blackline master workbook of the lab activities, an assessment workbook, a homework workbook and a guided reading workbook in hard copy student, teacher and online versions.

An analysis of the observation data indicated that teachers used the science kit program to help them engage students in inquiry based investigations. However, the overall theme learned from this data was that the inquiry activities were directed inquiry in nature, even in instances where the program materials indicated that the activity was supposed to be a guided inquiry activity. I found that teachers always provided the question to be explored as well as the materials and detailed procedures which would be used to conduct the investigations. This, by definition, means that it is a directed inquiry activity versus a guided inquiry activity where the students are engaged in planning and considering variables. Yet, I believe that this is a step in the right direction because teachers were able to make changes in their science practices from a more textbook centered "reading about" science at the beginning of the study towards more hands-on inquiry learning in science at the end of the study.

Factors Supporting/Inhibiting Instruction

In our discussions, a recurring theme from the group was that time presented perhaps the greatest challenge to implementing inquiry science learning within their classrooms. When discussing this in the focus group it was commented that the fourth grade curriculum included preparing students for the writing test, administered to all students in February, as well as reading and math. They seemed to feel the priority was to prepare students for reading, math, and writing - subjects that were tested at the fourth grade level.

> Mr. Winchester: "There is a definite crunch to fit in all the skills and experiences that students need for writing. Because we're tested in writing, we have to make sure the students are prepared for it, and there's only so much time in the day. What we do want to do in the future is have students do more writing about science to tie in with the hands on because hands on definitely sticks with the children."
>
> Ms. Kowalski: "We do feel the weight of being testing in reading, math, and writing, especially since that info is tracked and discussed a lot. I mean, we have meetings on the assessment data every month, at the school and to the district as well, so yeah, there definitely is that pressure, especially this year with the field writing test being so much earlier, too."
>
> Ms. Rosschire: "We do still have to teach science and the resources in the kits help you streamline things, but you only have so much time. Sometimes I feel like I want to do more experiments and get into topics more, but, you know, we have to move on. There's so much to fit in and keeping up with the pacing guide is difficult sometimes. This year, especially since we had to do the extra writing and we wanted to prepare the kids. So you do have to opt for helping give the kids what they need. It's a balancing act, and I hate to admit it but for the sake of time, sometimes you have to present the lesson in a more streamlined way. Even the teacher's guide gives you pointers for what to do when time is short. And it's not always an inquiry investigation."

Moreover, teacher survey responses indicated that there were three other factors that inhibited their science instruction: (1) selection of courses provided by the school district for science training, (2) time available for professional development and (3) consistency of science reform efforts with other school/district reforms. They were reluctant to comment on items related to school/district practices that may impact instruction. When probed further, the teachers indicated that the priority of other subjects seemed to take priority over science, but they weren't sure whether the pressure originated at the school, district, or state level. A persistent theme in this area indicated that this priority remains an overwhelming concern for teachers even though they have the resources to help them implement science as inquiry.

Planning, Collaboration, and Professional Development

As a general rule, the teachers participate in weekly team planning sessions. Thus, it was not surprising that teacher responses were identical with regards to the number of lessons taught per week and the number of units completed. Each teacher indicated they taught three lessons per week for an average duration of 41-50 minutes. By the end of the year, each of their classes had completed six units for the school year.

When I reviewed this with the team in our final meeting, the participants agreed that time was made available for them to plan and prepare lessons as a team, working together, and that they had all figured out a system of managing the resources in the kit. As they tried to implement science in the classroom, they reported feeling supported by their team members as they tried to implement their learning in the classroom. At the conclusion of this study, one teacher commented, "I enjoyed participating in this focus group because it gave me a chance to look at how I use science in my classroom and I was able to collaborate with peers on ways we could improve and enhance our lessons in the future." On the other hand, they made a point to emphasize the need for more science-related professional development, as well as the need for time to reflect on their learning as it relates to classroom application.

On the final survey, teachers were asked to what extent their team planning contributed to their content knowledge, understanding of how children learn think and learn about science, and their ability to implement high quality instructional materials. Teachers reported that team collaboration and planning had the greatest impact on their understanding of how children think and learn about science because they were able to discuss different strategies and benefit from their collective teaching experience with students. Team planning did not necessarily improve their science content knowledge, but provided opportunities for them to review the kit materials as well as plan for classroom and materials management.

Teachers stated that the actual inquiry kit contributed more to their content knowledge. They especially honed in on the section of the teacher guide that provided a summary of common misconceptions among students as they said this helped them feel more prepared to guide students towards correcting their misconceptions. The team spent approximately two hours per month on team planning and collaboration specifically on science, which was much less than the time spent planning in other content areas. The team noted that the planning time they spent together primarily included a review of the Sunshine State Standards to be taught and the lesson activities suggested by the district pacing guide, which was based on the adopted science program.

In terms of district provided professional development, teachers reported minimal participation for the school year on both their pre and post survey. At the beginning of the school year, they reported zero hours. By year end, two teachers did not report, and one teacher reported less than five hours. Since the team collaboration and planning activities focus on classroom and program management and does not necessarily reinforce science content, professional development is critical for teachers at the elementary level to assist them in improving their science content knowledge.

The overall picture that emerged here is that although the science kit materials provided support to teachers, such as the DVD and science articles, teachers need ongoing professional development in order to address their science content needs. Collaboration and planning time alone are insufficient to meet the diverse learning needs of the teachers.

Summary

The purpose of this study was to explore teachers' practices when using an inquiry based science kit program in fourth grade classrooms to determine if kit resources helped teachers feel better prepared for science instruction and observe their practices when using science kit materials. In analyzing the data collected through this study, several themes were revealed about the relationship between the use of kit resources and practices in the classroom. First, when teachers used the inquiry kits in the classroom, their perception of their preparedness to teach science and their ability to facilitate inquiry learning experiences for students was positively impacted. Second, in spite of the availability of such resources, teachers' struggled with the element of time as well as the perception of the priority science takes in light of other subjects at the fourth grade level. Third, teachers did change science teaching practices towards inquiry teaching, but teachers either modified or failed to use some of the components of the resources available in the kit. Finally, team collaboration and planning played an important role in encouraging teachers to use the inquiry kit program's resources but did not address science content needs.

In Chapter Five of this thesis report, my conclusions from this research study were presented as well as suggested areas of further research.

CHAPTER FIVE: CONCLUSIONS

Introduction

Teaching science as inquiry helps children develop scientific literacy and is the recommended method of teaching with students of all ages (Anderson, 2002; Ohana, 2006; NRC, 1996). This active learning approach has been shown to lead to higher achievement and improved critical thinking skills in all subject areas (Anderson, 2002; Dewey, 1910; Eshach, 2003; Fradd & Lee, 1999; NRC, 1996; National Science Foundation, 2000; Ohana, 2006). To support teachers in implementing science as inquiry, many curricular programs include science kits that are designed to encourage guided inquiry learning (Their, 2001). Since research suggested that teachers rely on instructional materials to structure lessons (Their, 2001), I wanted to find out whether an inquiry based science kit program impacted instruction. My research questions were:

- How well prepared did teachers feel when using a curricular program with inquiry kit materials to teach science as inquiry?
- How did teachers use the curricular program with inquiry kit resources in the classroom?

I was particularly interested in these questions because I saw a need to improve the depth of student content knowledge and increase test scores in science. I believed that teaching science as inquiry would enrich science knowledge for all.

Over the course of the study, several themes emerged. The first theme was that teachers perceived that they were better prepared to teach science as inquiry when using the science kit program. The second theme was that time available to teach science was limited due to perceptions about the priority of other subject content areas. The third theme was that teachers did change science teaching practices towards inquiry teaching using the kits. The fourth theme reflected that team collaboration was an important factor in teacher use of the science kits, but the kit's resources did not fully address science content needs.

Discussion

Based on my data, I concluded that teachers did feel better prepared when using the kits, and they used the kit resources to implement science as inquiry. As a result of the kits, teachers moved from simply reading about science and answering questions to focusing on an investigation question. The kits made it easier for teachers to prepare for science instruction as they became more familiar with the kit's materials. In addition to materials, teachers were provided with science content support and materials for students to engage and explore inquiry questions. One of the things I noted was that the science materials kits supported both directed inquiry and guided inquiry approaches to science lessons. However, in most cases, students were directed through the investigations as the teacher provided the investigation question, materials and procedures for the students to follow, making them more directed inquiry lessons. This leads me to conclude that use of science kits does not necessarily result in changes to classroom practices that will lead to lessons where students plan and consider other variables consistently, which is necessary in transitioning students towards making deeper connections and developing scientific literacy.

Lessons were structured using the 5E Instructional Model (Bybee et al., 2006) and teachers seemed adept at implementing the first two phases of the 5E Instructional Model: engagement and exploration. The questions and discussions teachers had with their students were engaging and such that encouraged the students to relate topics to their own personal experiences, which is important to inquiry learning (NRC, 1996). There was also evidence that teachers felt that the kits also helped them with the third phase (explain) of the 5E Instructional Model by providing content background and knowledge to help them interpret the results of the experiment, but teachers were less adept at implementing the final two phases (elaboration and evaluation). This is perhaps because of the limited professional development teachers received in the area of science as the kits did not fully address science content needs of the educator. Since elementary teachers often lack sufficient content knowledge and have not experienced inquiry learning as students themselves (Bentley et al., 2007), there is a need for additional support beyond the kit to help them be better prepared to teach science as inquiry.

Traditionally, this can be addressed with ongoing professional development programs. One study completed by Supovitz & Turner (2000) found that professional development programs which were intensive and sustained led to changes in teacher practices after 80 hours of professional development. Their work also indicated that changes to teacher practices were seen when professional development efforts was coupled with curriculum based materials based on the national standards that contained sequenced, grade-level appropriate, and content rich activities (Supovitz & Turner, 2000). Another issue that occurs when teachers have limited professional development training and support is that there is the risk that they will alter and adapt the curriculum from its intended purpose (Cronin-Jones as cited in Jones & Eick, 2007a). Teachers in this study adapted materials that were intended to be used as student investigations and used them as teacher demonstrations. One teacher used the teacher instructional DVD as a model to guide students through and experiment.

I also posit that team collaboration and planning was critical in encouraging teachers to use the inquiry based programs. Research indicates that strong, collaborative relationships, especially at the elementary level are important (Bentley et al., 2007) in that they provide opportunities for teachers to reassess and reflect upon their own beliefs and learn from each other (Anderson, 1996, 2002; Czerniak et al., 1999).

Lack of resources is often cited as an impediment to implementing science as inquiry (Czerniak et al, 1999; Jones & Eick, 2007a, 2007b; Shimkus & Banilower, 2004). The results of this study found that teachers had ample materials and this was not a factor. Teachers were more discouraged by the lack of time when trying to utilize reform based instruction in the classroom. The pressure to prepare students for state mandated testing and the priority of reading, math and writing proved to hamper efforts at conducting student-centered inquiry lessons. This was another reason cited as why teachers opted to use the materials as teacher demonstrations rather than student inquiries.

Changing teacher practices is not an easy task and takes time (Fullan, 2007). One theme I discovered was that teachers may perceive that they are practicing inquiry when in fact they are not. Teacher responses and observation data revealed teacher perceptions and actions differed. Teachers need opportunities to reflect on their actual practices.

The findings of this study indicated that it is possible for teachers to implement science as inquiry when supported with high quality instructional materials. However, there is a need for additional support, such as professional development and time to plan and collaborate with others involved in the implementation process.

Limitations

My first limitation dealt with the participants involved in the study. This study was conducted with three fourth grade teachers with three to six years teaching experience. Expanding the participants to include teachers of other grade levels could provide different insights into their use of science inquiry materials. It would be interesting to see if middle and high school teachers face similar challenges with time. In addition, the teachers were favorable towards wanting to incorporate the program's materials in their classrooms. Results can not be globally applied to teachers of other grade levels or to teachers who are not predisposed towards wanting to implement science as inquiry.

Another limitation of this study was time. This study was conducted during a single school year and was hampered by scheduling conflicts. The biggest problem I encountered was when the school was randomly chosen to participate in the FCAT Writing field test. Teachers' focus shifted towards preparing students for the FCAT examination earlier than expected, which delayed planned lessons.

Another limitation was the curricular program used. There are numerous available programs designed to coincide with the National Science Education Standards (NRC, 1996) and support inquiry based teaching practices. Teachers may interact with other materials differently.

Recommendations

The biggest lesson I learned from this research is that the likelihood of materials remaining unused is high unless we can incorporate more activities where teachers are interacting with the science inquiry-based materials. If doing this study again, I would focus on how ongoing professional development sessions throughout the school year outside of the classroom would impact teacher practices. I would like to see teachers using the resources in the materials kits by participating in the guided inquiry investigations as learners. I would want to work together to change the activities from step-by-step procedures to make them less teacher directed to more student-centered inquiry investigations. As a follow up, teachers would be observed and video taped facilitating the lessons in which they had participated as learners. In this study, I found that teacher perceptions and practices differed. One way to match their perceptions with reality would be to have them view their video taped observations so that they can reflect on their practices.

Another change I would make to this study would be to have more consistent observation data. I would want to establish a schedule to check in with teachers weekly at designated timeframes when science lessons are scheduled and track whether or not those lessons are being conducted. If a lesson had been postponed, I would like to track and document reasons for the interruptions. This would provide more data as to how often science lessons take a lesser priority than other activities.

To expand the scope of this study, I would include a larger group of participants to include teachers at a variety of grade levels. It would also be interesting to see if new teachers are coming into the profession more prepared to teach science. A number of studies have been done with regards to teacher preparation programs (Fullan, 2007; Hayes, 2002; Kelly, 2000; Neiss, 2003; Scantlebury, 2008). Perhaps changes have been made that provide teachers with greater content knowledge and support.

Summary

I believe that commercial kit based programs can provide a framework for helping teachers help students connect big ideas and themes (Roehrig & Kruse, 2005) by providing them with concepts for study and scaffolded activities (Jones & Eick, 2007b). Teachers feel better prepared and are more likely to incorporate science regularly in classroom activities when they have materials readily accessible to them. However, teachers need to be taught how to use the materials appropriately and should experience inquiry learning with their peers in collaborative environments where they have time to reflect upon their practices.

APPENDIX A: ORANGE COUNTY PUBLIC SCHOOLS APPROVAL

Submit this form and a copy of your proposal to:
Accountability, Research, and Assessment
P.O. Box 271
Orlando, FL 32802-0271

Orange County Public Schools

RESEARCH REQUEST FORM

Your research proposal should include:
- Project Title
- Purpose and Research Problem
- Instruments
- Procedures and Proposed Data Analysis

Requester's Name Angela Clayton — Date 9/28/2007

Address 2920 Noah Circle, St. Cloud, FL 34772 — Phone 407-858-5920 x2233

Institutional Affiliation University of Central Florida

Project Director or Advisor Dr. Bobby Jeanpierre — Phone 407-823-4930

Address 400 Central Florida Blvd. UCF Orlando, FL 32816

Degree Sought: (check one) ☐ Associate ☐ Doctorate ☐ Bachelor's ☐ Not Applicable ☒ Master's ☐ Specialist

Project Title: Case study on teacher attitudes regarding inquiry based science teaching and the implementation of inquiry strategies in an elementary classroom

ESTIMATED INVOLVEMENT

PERSONNEL/CENTERS	NUMBER	AMOUNT OF TIME (DAYS, HOURS, ETC.)	SPECIFY/DESCRIBE GRADES, SCHOOLS, SPECIAL NEEDS, ETC.
Students	0		
Teachers	3-4	15 wks (1-2 hrs per wk)	4th grade teachers
Administrators			
Schools/Centers	1	15 wks (1-2 hrs per wk)	West Creek Elementary
Others (specify)	3	3 days	Workshops, Professional Development

Specify possible benefits to students/school system: The study could provide insight into the types of professional development activities that could support teachers use of inquiry based strategies to teach science, strengthen teacher knowledge about scientific concepts; best practices, barriers, and attitudes that affect inquiry based teaching methods.

ASSURANCE

Using the proposed procedures and instrument, I hereby agree to conduct research in accordance with the policies of the Orange County Public Schools. Deviations from the approved procedures shall be cleared through the Senior Director of Accountability, Research, and Assessment. Reports and materials shall be supplied as specified.

Requester's Signature *Angela M. Clayton*

Approval Granted: ☒ Yes ☐ No Date: *10-5-07*

Signature of the Senior Director for Accountability, Research, and Assessment *Lee Baldwin*

NOTE TO REQUESTER: When seeking approval at the school level, a copy of this form, signed by the Senior Director, Accountability, Research, and Assessment, should be shown to the school principal who has the option to refuse participation depending upon any school circumstance or condition. The original Research Request Form is preferable to a faxed document.

Reference School Board Policy GCS, p. 249

RECEIVED OCT 2 2007

OCPS1044ARA (Revised 6/07)

UCF University of Central Florida IRB
IRB NUMBER: SBE-07-05207
IRB APPROVAL DATE: 11/2/2007
IRB EXPIRATION DATE: 11/1/2008

APPENDIX B: UNIVERSITY OF CENTRAL FLORIDA INSTITUTIONAL REVIEW BOARD APPROVALS

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Notice of Expedited Initial Review and Approval

From : **UCF Institutional Review Board**
FWA00000351, Exp. 5/07/10, IRB00001138

To : **Angela Clayton**

Date : **November 02, 2007**

IRB Number: **SBE-07-05207**

Study Title: **Teacher Practices in implementing and using an Inquiry Based Science Program**

Dear Researcher:

Your research protocol noted above was approved by **expedited** review by the UCF IRB Vice-chair on 11/2/2007. **The expiration date is 11/1/2008.** Your study was determined to be minimal risk for human subjects and expeditable per federal regulations, 45 CFR 46.110. The category for which this study qualifies as expeditable research is as follows:

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The IRB has approved a **consent procedure which requires participants to sign consent forms.** Use of the approved, stamped consent document(s) is required. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Advise the IRB if you receive a subpoena for the release of this information, or if a breach of confidentiality occurs. Also report any unanticipated problems or serious adverse events (within 5 working days). Do not make changes to the protocol methodology or consent form before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at http://iris.research.ucf.edu .

Failure to provide a continuing review report could lead to study suspension, a loss of funding and/or publication possibilities, or reporting of noncompliance to sponsors or funding agencies. The IRB maintains the authority under 45 CFR 46.110(e) to observe or have a third party observe the consent process and the research.

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 11/02/2007 10:38:14 AM EST

Janice M Turchin

IRB Coordinator

University of
Central
Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

From : **UCF Institutional Review Board**
FWA00000351, Exp. 6/24/11, IRB00001138

To : **Angela Clayton**

Date : **September 18, 2008**

IRB Number: **SBE-07-05207**

Study Title: **Teacher Practices in implementing and using an Inquiry Based Science Program**

Dear Researcher,

This letter serves to notify you that the continuing review application for the above study was reviewed and approved by the IRB Chair on **9/18/2008** through the expedited review process according to 45 CFR 46 (and/or 21 CFR 50/56 if FDA regulated).

Continuation of this study has been approved for a one-year period. The expiration date is 9/17/2009. This study was determined to be no more than minimal risk and the categories for which this study qualified for expedited review are:

6. Collection of data from voice, video, digital, or image recordings made for research purposes.

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

<u>Use of the approved, stamped consent document(s) is required.</u> The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Use the Unanticipated Problem Report Form or the Serious Adverse Event Form (within 5 working days of event or knowledge of event) to report problems or events to the IRB. Do not make changes to the study (i.e., protocol methodology, consent form, personnel, site, etc.) before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **<u>cannot</u>** be used to extend the approval period of a study. All forms may be completed and submitted online at <u>https://iris.research.ucf.edu</u> .

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 09/18/2008 12:42:23 PM EDT

Joanne Muratori

IRB Coordinator

APPENDIX C: PARTICIPANT CONSENT

November, 2007

I am a graduate student at the University of Central Florida. As part of my coursework, I am conducting a thesis research project. This research study will be based on working with teachers to investigate their attitudes towards using an inquiry based science program in an elementary classroom, and will look at how teachers use an inquiry based program to implement science instruction. You are invited to participate in this study to contribute to the understanding of successes and challenges when implementing an inquiry-based science program. Teachers involved in this study will be asked to complete the following activities:

1. Pre and post survey concerning personal attitudes, opinions, and science teaching practices.
2. Team planning and collaboration regarding science lessons and instructional strategies.
3. Observations by the principal investigator, who will take field notes during science instruction in your classroom. Each observation session will be scheduled with you and will last for the approximately 20-40 minutes. With your permission, these sessions will be audio taped.
4. Individual interview with the principal investigator following classroom observations.
5. Focus Group session at the end of the study where we will discuss, as a team, your experiences in team planning/collaboration and your teaching practices using the inquiry based program.

Your identity will be kept confidential and will not be revealed in the final manuscript. The audiotapes and all other information obtained during this research project will be kept secure, locked in a file cabinet accessible only to me. The audiotapes will be transcribed and coded to remove individuals' names and will be erased after the project is completed

I do not anticipate any risk to this study. There are several potential benefits to this study. I expect that the results of this study will increase our understanding of the effects of an inquiry based science program on teachers ability to implement strategies successfully in the classroom and help me investigate the role teachers' personal beliefs, team collaboration, and professional development support have in the implementation of inquiry based teaching

You will not receive payment for taking part in this study; however, you will receive staff development points for participating in planning sessions at the rate of one staff development point per hour of team planning staff development participation. Your participation in this project is completely voluntary, and you are free to withdraw at any time and for any reason without penalty. Should you choose to withdraw, you would be able to keep staff development points already earned. Your choice to participate or decline participation will not impact your job or status at school. You are also free to refuse to answer any questions you do not wish to answer.

In order to collect data for this study from you, your written permission is required. This study will be conducted during the regular contracted hours. If you agree to participate in this research study, please sign the consent area below and return it to me as soon as possible. By signing this letter, you give me permission to report your responses anonymously in the final manuscript to be submitted to my Faculty Advisor as part of my course work.

If you have any questions about this research project, please contact me by telephone at 407-948-5300 or by e-mail at angieclay@cfl.rr.com.

Questions or concerns about research participants' rights may be directed to the UCF IRB Office University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is (407) 823-2901.

Sincerely,

Angela M. Clayton

UCF Faculty Advisor
Dr. Bobby Jeanpierre, Ph.D., M.A.
University of Central Florida
bjeanpie@mail.ucf.edu
407-823-4930.

I have read the procedures described above. I voluntarily agree to participate in the research project procedures. I have been given a copy of this consent form. I am at least 18 years of age and able to give my own consent to participate in this study.

______ Yes, I agree to participate in the study.

______ No, I will not participate in the study

Participant Signature   Date

I also understand that sessions in which I participate will be audio taped. My signature below gives my permission to audio tape me in the sessions. I understand that tapes will be maintained until analyzed and/or transcribed for the research project and then destroyed by the principal investigator.

Participant Signature   Date

UCF University of Central Florida IRB
IRB NUMBER: SBE-07-05207
IRB APPROVAL DATE: 11/2/2007
IRB EXPIRATION DATE: 11/1/2008

APPENDIX D: PRE & POST SURVEY QUESTIONNAIRE

Teacher Pre-Survey

Teacher Opinions & Preparedness

Please provide your opinion about each of the following statements

	Strongly Disagree	Disagree	No opinion	Agree	Strongly Agree
Students generally learn science best in classes with students of similar abilities.					
I feel supported by colleagues to try out new ideas in teaching science.					
Teachers in this school have a shared vision of effective science instruction					
Teachers in this school regularly share ideas and materials related to science.					
Teachers in this school are well-supplied with materials for investigative science instruction.					
I have time during the regular school week to work with my peers on science curriculum and instruction.					
I have adequate access to computers for teaching science					
I enjoy teaching science.					
I am well-informed about the NRC *National Science Education Standards* for the grade level I teach.					
The science program in this school is strongly supported by local organizations, institutions, and/or business					

In the left section, please rate each of the following in terms of its importance for effective science instruction in the grade you teach. In the right section, please indicate how **prepared** you feel to do each one. (Choose only one in each section on each line)

	Not important	Some-what Important	Fairly Important	Very Important		Not Adequately Prepared	Some-what Prepared	Fairly Well Prepared	Very Well Prepared
Provide concrete experience before abstract concepts.									
Develop students' conceptual understanding of science.									
Take students' prior understanding into account when planning curriculum and instruction									
Make connections between science and other disciplines.									
Have students work in cooperative learning groups.									
Have students participate in appropriate hands-on activities									
Engage students in inquiry oriented-activities.									
Use computers									
Engage students in applications of science in a variety of contexts.									
User performance-based assessment.									
Use portfolios									
Use informal questioning to assess student understanding.									

UCF University of Central Florida IRB
IRB NUMBER: SBE-07-0520?
IRB APPROVAL DATE: 11/2/2007
IRB EXPIRATION DATE: 11/1/2008

Many teachers feel better prepared to teach some subject areas than others. How well prepared do you feel to teach each of the following subjects at the grade level you teach, whether or not they are currently included in your curriculum?

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Science				
Mathematics				
Reading/Language Arts				
Social Studies				

Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade level you teach, whether they are currently included in your curriculum?

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
The human body				
Ecology				
Rocks and soils				
Astronomy				
Processes of change over time (evolution)				
Mixtures and solutions				
Electricity				
Sound				
Forces and motion				
Machines				
Engineering and design principles (e.g. structures, models)				

Please indicate how well prepared you feel to do each of the following.

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Lead a class of students using investigative strategies.				
Manage a class of students engaged in hands-on/project based work.				
Help students take responsibility for their own learning.				
Use strategies that specifically encourage participation of females and minorities in science.				
Involve parents in the science instruction of their students.				
Recognize and respond to student diversity.				

Please rate the effect of the following on your science instruction.

	Inhibits effective Instruction	Neutral or Mixed	Encourages Effective Instruction	N/A or Don't Know
State and/or district curriculum frameworks.				
State and/or district testing policies and practices.				
Quality of available instructional materials				
Access to computers for science instruction.				
Funds for purchasing equipment and supplies for science.				
System of managing instructional resources provided by the science resource kit				
Time available for teachers to plan and prepare lessons.				
Time available for teachers to work with other teachers.				
Time available for teacher professional development.				
Selection of courses provided by your school/district for science training.				
Consistency of science reform efforts with other school/district reforms				
Importance the school places on science.				
Importance the district places on science				

Your Science Teaching

How many lessons per week do you typically teach science? (Choose one)

Number of Lessons

0 ___ 1_____ 2 3________ 4___ 5 __________

Approximately how many minutes is a typical science lesson? (Choose one)

Average Number of Minutes per Lesson

10 or fewer	11-20	21-30	31-40	41-50	51-60	60 or more
______	______	______	______	______	______	______

How many science units has this class worked on so far this academic year? (A unit is defined as a series of related activities, often on a single topic such as sound, rocks, or genetics.)

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

5

How long do your science units typically last? (Choose only one)

___ 1 Week
___ 2 Weeks
___ 3 Weeks
___ 4 Weeks
___ 5 Weeks
___ 6 Weeks
___ 7 Weeks
___ 8 Weeks
___ 9 Weeks
___ 10+ Weeks

About how often do **you** do each of the following in your science instruction (Choose only one per line)

	Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all science lessons
Use the SF district designated instruction materials as the basis for science lessons.					
Introduce content through formal presentations.					
Demonstrate a science-related principle or phenomenon					
Teaching science using real-world contexts.					
Arrange seating to facilitate student discussion.					
Use open-ended questions					
Require students to supply evidence to support their claims					
Encourage students to explain concepts to one another.					
Encourage students to consider alternative explanations.					
Allow students to work at their own pace.					
Help students see connections between science and other disciplines.					
Use assessment to find out what students know before or during a unit.					
Embed assessment in regular class activities					
Assign science homework.					
Incorporate student notebooks or journals where they can read and comment on activities, concepts, and lessons.					
Read and comment on the reflections students have written in their notebooks or journals.					

About how often do **students** in your **class** take part in each of the following types of activities as part of their science instruction (Choose only one oval per line).

	Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all science lessons
Participate in student-led discussions.					
Participate in discussions with the teacher to further science understanding.					
Work in cooperative learning groups.					
Make formal presentations to the class.					
Read from a science textbook in class.					
Read other (non-textbook) science-related materials in class					
Answer textbook/worksheet questions					
Review homework/worksheet assignments.					
Work on solving a real-world problem.					
Share ideas or solve problems with each other in small groups.					
Engage in hands-on science activities					
Follow specific instructions in an activity or investigation.					
Design or implement their own investigation					
Design objects within constraints (e.g. egg drop, toothpick bridge, aluminum boats).					
Work on models or simulations					
Work on extended science investigations or projects (a week or more in duration)					
Record, represent, and/or analyze data.					
Write reflections in a notebook or journal					
Prepare written science reports					
Use computers					
Work on portfolios					
Take short-answer tests (e.g., multiple choice, true/false, fill-in the blank)					
Take tests requiring open-ended responses (e.g., descriptions, explanations)					

Professional Development

	Not at all 1	2	3	4	To a great extent 5
I am involved in planning my science-related professional development.					
I am encouraged to develop an individual professional development plan to address my needs and interests related to science education.					
I am given time to reflect on what I've learned and how to apply it to the classroom					
I receive support as I try to implement what I have learned.					
I need more science-related professional development					

Approximately how many **total hours** have you spent on formal, district provided professional development in science/science education this academic school year?

Teacher Post-Survey

Teacher Opinions & Preparedness

Please provide your opinion about each of the following statements.

	Strongly Disagree	Disagree	No opinion	Agree	Strongly Agree
Students generally learn science best in classes with students of similar abilities.					
I feel supported by colleagues to try out new ideas in teaching science.					
Teachers in this school have a shared vision of effective science instruction.					
Teachers in this school regularly share ideas and materials related to science.					
Teachers in this school are well-supplied with materials for investigative science instruction.					
I have time during the regular school week to work with my peers on science curriculum and instruction.					
I have adequate access to computers for teaching science.					
I enjoy teaching science.					
I am well-informed about the NRC *National Science Education Standards* for the grade level I teach.					
The science program in this school is strongly supported by local organizations institutions, and/or business					

In the left section, please rate each of the following in terms of its importance for effective science instruction in the grade you teach. In the right section, please indicate how **prepared** you feel to do each one. (Choose only one in each section on each line)

	Not Important	Somewhat Important	Fairly Important	Very Important	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Provide concrete experience before abstract concepts.								
Develop students' conceptual understanding of science.								
Take students' prior understanding into account when planning curriculum and instruction.								
Make connections between science and other disciplines.								
Have students work in cooperative learning groups								
Have students participate in appropriate hands-on activities.								
Engage students in inquiry oriented-activities.								
Use computers								
Engage students in applications of science in a variety of contexts.								
User performance-based assessment.								
Use portfolios								
Use informal questioning to assess student understanding.								

Many teachers feel better prepared to teach some subject areas than others. How well prepared do you feel to teach each of the following subjects at the grade level you teach, whether or not they are currently included in your curriculum?

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Science				
Mathematics				
Reading/Language Arts				
Social Studies				

Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics at the grade level you teach, whether they are currently included in your curriculum?

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
The human body				
Ecology				
Rocks and soils				
Astronomy				
Processes of change over time (evolution)				
Mixtures and solutions				
Electricity				
Sound				
Forces and motion				
Machines				
Engineering and design principles (e.g. structures, models)				

Please indicate how well prepared you feel to do each of the following.

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Lead a class of students using investigative strategies				
Manage a class of students engaged in hands-on/project based work.				
Help students take responsibility for their own learning.				
Use strategies that specifically encourage participation of females and minorities in science.				
Involve parents in the science instruction of their students.				
Recognize and respond to student diversity.				

Please rate the effect of the following on your science instruction.

	Inhibits effective Instruction	Neutral or Mixed	Encourages Effective Instruction	N/A or Don't Know
State and/or district curriculum frameworks.				
State and/or district testing policies and practices.				
Quality of available instructional materials.				
Access to computers for science instruction.				
Funds for purchasing equipment and supplies for science.				
System of managing instructional resources provided by the science resource kit.				
Time available for teachers to plan and prepare lessons.				
Time available for teachers to work with other teachers.				
Time available for teacher professional development.				
Selection of courses provided by your school/district for science training.				
Consistency of science reform efforts with other school/district reforms.				
Importance the school places on science.				
Importance the district places on science.				

Your Science Teaching

How many lessons per week do you typically teach science? (Choose one)

Number of Lessons

0 ____ 1 ____ 2 ____ 3 ____ 4 ____ 5 ____

Approximately how many minutes is a typical science lesson? (Choose one)

Average Number of Minutes per Lesson

10 or fewer	11-20	21-30	31-40	41-50	51-60	60 or more
____	____	____	____	____	____	____

How many science units has this class worked on so far this academic year? (A unit is defined as a series of related activities, often on a single topic such as sound, rocks, or genetics.)

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

UCF University of Central Florida IRB
IRB NUMBER: SBE-07-05207
IRB APPROVAL DATE: 11/1/2007
IRB EXPIRATION DATE: 11/1/2008

How long do your science units typically last? (Choose only one)

___ 1 Week
___ 2 Weeks
___ 3 Weeks
___ 4 Weeks
___ 5 Weeks
___ 6 Weeks
___ 7 Weeks
___ 8 Weeks
___ 9 Weeks
___ 10+ Weeks

About how often do **you** do each of the following in your science instruction (Choose only one per line)

	Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all science lessons
Use the SF district designated instruction materials as the basis for science lessons.					
Introduce content through formal presentations.					
Demonstrate a science-related principle or phenomenon					
Teaching science using real-world contexts.					
Arrange seating to facilitate student discussion.					
Use open-ended questions					
Require students to supply evidence to support their claims					
Encourage students to explain concepts to one another.					
Encourage students to consider alternative explanations.					
Allow students to work at their own pace.					
Help students see connections between science and other disciplines.					
Use assessment to find out what students know before or during a unit.					
Embed assessment in regular class activities					
Assign science homework.					
Incorporate student notebooks or journals where they can read and comment on activities, concepts, and lessons.					
Read and comment on the reflections students have written in their notebooks or journals.					

About how often do **students** in your **class** take part in each of the following types of activities as part of their science instruction (Choose only one oval per line).

	Never	Rarely (e.g. a few times a year)	Sometimes (e.g. once or twice a month)	Often (e.g. once or twice a week)	All or almost all science lessons
Participate in student-led discussions.					
Participate in discussions with the teacher to further science understanding.					
Work in cooperative learning groups.					
Make formal presentations to the class.					
Read from a science textbook in class.					
Read other (non-textbook) science-related materials in class					
Answer textbook/worksheet questions					
Review homework/worksheet assignments.					
Work on solving a real-world problem.					
Share ideas or solve problems with each other in small groups.					
Engage in hands-on science activities					
Follow specific instructions in an activity or investigation.					
Design or implement their own investigation					
Design objects within constraints (e.g. egg drop, toothpick bridge, aluminum boats).					
Work on models or simulations					
Work on extended science investigations or projects (a week or more in duration)					
Record, represent, and/or analyze data.					
Write reflections in a notebook or journal					
Prepare written science reports					
Use computers					
Work on portfolios					
Take short-answer tests (e.g., multiple choice, true/false, fill-in the blank)					
Take tests requiring open-ended responses (e.g., descriptions, explanations)					

Professional Development

	Not at all 1	2	3	4	To a great extent 5
I am involved in planning my science-related professional development.					
I am encouraged to develop an individual professional development plan to address my needs and interests related to science education.					
I am given time to reflect on what I've learned and how to apply it to the classroom					
I receive support as I try to implement what I have learned.					
I need more science-related professional development					

Approximately how many **total hours** have you spent on formal, district provided professional development in science/science education this academic school year?

Approximately how many **total hours** have you spent on team planning/collaboration related to science strategies and instruction?

To what extent do you feel that your participation in team planning has contributed to your:

	Not at all				To a great extent
	1	2	3	4	5
Science content knowledge					
Understanding of how children thing about/learn science					
Ability to implement high quality science instructional materials					

To what extent do you feel that the program's inquiry kit has contributed to your:

	Not at all				To a great extent
	1	2	3	4	5
Science content knowledge					
Understanding of how children thing about/learn science					
Ability to implement high-quality science instructional materials					

Thank you very much for participating in this survey!

APPENDIX E: FOCUS GROUP QUESTIONS

Focus Group Questions

How would you describe your attitude towards inquiry based instruction?

What are your biggest challenges with implement science instruction in the classroom?

What do you consider your strengths/weaknesses with using inquiry based science strategies?

How did the inquiry kit support your science instruction? Were there ways in which your instruction was hindered or limited by the use of the kit?

Describe your plan to use inquiry in the future?

What would you like to see change about your knowledge or instruction of science?

Are there any other comments you would like to share?

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