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The Use Of Science Reform Instructional Methods And Their Effect On 3rd Grade Students' Participation And Attitude Towards S

Heather Robinson
University of Central Florida

THE USE OF SCIENCE REFORM INSTRUCTIONAL METHODS AND THEIR EFFECT ON 3RD GRADE STUDENTS' PARTICIPATION AND ATTITUDE TOWARDS SCIENCE

by

HEATHER ANN ROBINSON
B.S. University of Central Florida, 2000

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ABSTRACT

The purpose of this research study was to determine whether the use of science reform instructional methods had an effect on student participation in and attitudes towards science education. The participants in this 12 week study were third grade students. Data were collected using a pre and post attitudinal survey, student journals, a participation log, and a researcher reflection journal. Several conclusions were made. The use of science reform instructional methods did affect student participation and attitudes towards science. Student journals indicated that students enjoyed the use of technology, hands-on science equipment, working in pairs or small groups and the opportunity to share their ideas and learn from their classmates. This study does lend itself to additional research. Due to the small sample size, the shortened time for research, and the population, these research questions should be investigated with another group of students in order to make more definitive decisions regarding the methods to use in their classroom. If the research is conducted again using a different group of students, a larger population will be needed, as well as a lengthened period for research.

I would like to dedicate this action research thesis to my husband, Tom, whose support enabled me to reach my goal of becoming a better teacher for my students.

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I would like to thank the professors that worked with me throughout my program and believed in me even when I doubted myself. I would specifically like to thank Dr. Gresham and Dr. Jeanpierre who encouraged me and were patient with my shortcomings. It is with your guidance that I was able to complete my thesis.

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LIST OF ACRONYMS/ABBREVIATIONS

NRC	National Research Council
NSES	National Science Education Standards
NSF	National Science Foundation

CHAPTER ONE: INTRODUCTION

As society has become more dependent upon scientific advances, the need for more interesting and effective science education has grown. Research indicates that students feel science is irrelevant to life and are choosing careers other than science (Kennedy, 1998; Linn, 1992; Millar, Osborne, & Nott, 1998). The more traditional approach to teaching science education has consisted of reading texts, answering questions, and completing isolated lab experiments. These traditional approaches have become ineffective (Kennedy, 1998; Linn, 1992; Millar, Osborne, & Nott, 1998). Research has indicated a need to restructure instructional approaches to meet the needs of the learner.

The purpose of this study was to determine the effects of science reform instructional methods on student participation in and attitudes towards science education. The effects of a science reform instructional method can be influenced by beliefs and proper implementation of the teaching strategy. The research supported that students involved in science inquiry education developed more positive attitudes towards and had a greater involvement in their science education (Chang & Mao, 1999; Gerber, Cavallo & Marek, 2001; Jarvis & Pell, 2004; NSF, n.d.)

The action research study focused on two major questions:

Question #1 Did the use of science reform instructional methods affect student participation during science instruction?

Question #2 Did the use of science reform instructional methods affect student attitudes towards science content and instruction?

Question #1 was asked because I wanted to find an instructional method that would help students increase their level of participation in science. Question #2 was asked to determine student attitudes towards science content and instruction. I wanted to see if using science reform instructional methods would encourage students to become more actively involved in their science education.

Rationale

Science content was always quite illusive to me when I was in school. I memorized the information, did well on the tests, and could even argue a few select points, but I had a very limited understanding and lacked the desire to learn the information on my own. I saw science as a meaningless body of information. Even in high school, when we conducted experiments, I did well. However, I did not understand why my outcome was correct or incorrect, or what I was supposed to learn from the experiment. I only understood that certain chemicals should not be combined. I left school with very little background and comprehension of scientific concepts.

When I began teaching, I struggled with how to teach science in a meaningful way. My limited understanding caused me to rely heavily on the textbook and left little room for hands-on or enrichment activities. I was not versed well enough in scientific concepts to deal with an unexpected result. I began to look for opportunities to develop my own scientific understanding. I hoped that my increased comprehension would lead to more interesting and productive science lessons that encouraged students to learn science and formulate their own understanding with less rote memorization. I began learning about the inquiry approach to teaching and felt that this would greatly improve students' participation in and attitudes towards science education.

As I learned about inquiry science education, I began to implement it into my own classroom. I noticed that my students were more actively involved and enthusiastic when learning scientific concepts and were more engaged in the learning process. Many began to develop a deeper level of understanding regarding the content and were able to apply their knowledge to other situations. I wanted to know how my use of science reform instructional methods affected students' participation and attitudes.

Significance

Questioning was prevalent during the time of Socrates, Aristotle, Plato, Galileo and other renowned philosophers. Groups of people would gather in the market place to discuss ideas and daily issues. People learned from each other and developed their own understandings of the world around them by engaging in group discussions. This type of learning is supported by Vygotsky's Social Development Theory, which states that social interactions lend themselves heavily to knowledge acquisition. He also states that everything a child learns is first understood from a social aspect and then from an individual perspective (Vygotsky, 1978).

The idea of social, collaborative, interactive learning was strongly supported by Dewey. He advocated a school system that put students at the center of education and held the students responsible for their own learning. Students would be immersed into situations that provided them with countless opportunities to develop their own understanding regarding a multitude of ideas. Dewey believed that children would have a greater understanding of the content if they constructed their own understanding, rather than memorizing predetermined facts (Dewey, 1910).

Young children, by nature, try to make sense of the world around them prior to entering the educational system (Gerber, Cavallo, & Marek, 2001). Piaget (1964) believed that we should not always accept information as true, but should rather question it and confirm it with evidence. This idea is the basis of inquiry which includes gathering information, collecting and interpreting data, formulating hypotheses, and drawing logical conclusions (Chang & Mao, 1999; Lee & Songer, 2003; NRC, 2005; NSF, n.d.), as well as sharing findings with others (Lee & Songer, 2003; NRC, 2005; NSF, n.d.). Based upon their research studies, Hendrix (1996) and Hodson (1990) concluded that students who participated in a cooperative learning community developed more positive attitudes regarding the concept they were studying. Research conducted by Johnson and Johnson (1989) showed that participation levels increased when students were involved in cooperative learning. Students felt more confident in taking risks and problem solving when they were working with other students to achieve a common goal (Hendrix, 1996; Johnson & Johnson, 1989). The purpose of this action research study was to investigate whether the use of a science inquiry-based instructional method affected student participation and attitude towards science content and instruction.

Assumptions

I approached this study with the assumption that the use of an inquiry instructional method would have a positive effect on student participation in and attitudes towards science education. I based this assumption on a thorough review of the literature and upon my professional experience as an educator. I assumed that students would be honest when writing their journal responses and would not feel they would be penalized for negative answers. Finally, I assumed that my predisposition regarding the effectiveness of science reform instructional methods would not interfere with my ability to report my findings in an unbiased manner.

Definitions

Attitude: "…demonstrate belief in one's ability to understand science; explore the role of science in society and culture" (Sanfeliz & Stalzer, 2003).

Guided inquiry: Guided inquiry is a type of inquiry where the teacher assists the students in making decisions regarding the direction of their inquiry. Guided inquiry education causes students to work through conflict in their minds concerning their knowledge and experiences in order to develop deeper understanding of the science itself (Gerber, Cavallo, & Marek, 2001).

Hands on approach: refers to the use of science equipment and manipulatives to further the understanding of students when conducting an investigation into a scientific concept.

Instructional methods: "the elements included in instruction for the purpose of supporting the achievement of the learning objective" (Reiser & Dempsey, 2007, p. 314).

Journal writing: A science journal is a place where students can reflect upon the day's activities, write questions they would like to explore, and work out areas of confusion that they need to address (Klentschy, 2005; Shepardson & Britsch, 1997).

Learning modalities: "refer to the style learners use to concentrate on, process, and retain information…" (Hutinger, 2007).

Participation: According to Bonwell and Eison (1991) participation can also be called active learning. Active learning "involves students in doing things and thinking about the things they are doing....students must do more than just listen: They must read, write, discuss, or be engaged in solving problems. Most important, to be actively involved, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation" (Bonwell & Eison, 1991, p. 2).

Reform instructional methods: In this research project, reform instructional methods refer to the use of multiple instructional methods designed to encourage participation and positive attitudes in students. They include small group activities, small discussion groups, whole group activities, whole group discussions, pairs, individual research with technology, demonstration, and guided inquiry.

Science inquiry: As stated in the 1996 publication by the National Research Council entitled National Science Education Standards, science inquiry is the "diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work" (NRC, 1996, p. 23).

Overview

Determining the effects of a science reform instructional method on student participation in and attitudes towards science education was the primary focus of this study. Chapter two was the literature review that addressed the changes that have occurred in regards to science education pedagogy. It also discussed what inquiry entails and its affects on student participation in and attitudes towards science education. Finally, it addressed the use of journal writing in the classroom. Chapter three was the description of the research methodology. It discussed how the research was organized, the participants and how they were selected, the instruments used and demographic information. Chapter four was the interpretation of the data and its effects on student participation in and attitudes towards science education. Finally, chapter five discussed the conclusions drawn from the data analysis and recommendations for future research in regards to science inquiry and student participation in and attitudes towards science.

CHAPTER TWO: LITERATURE REVIEW

Introduction

Research suggests that students who are taught using an inquiry-based instructional method have more positive attitudes towards science and are more inclined to participate in their own science education (Chang & Mao, 1999; Gerber, Cavallo & Marek, 2001; Jarvis & Pell, 2004; Maaka, 1999). The ideology of the best manner in which to teach science has undergone numerous changes over the last several decades. Dewey argued that students needed to learn about the world and its relevancy to their daily lives. This was done using an inquiry approach to learning (DeBoer, 2000; Dewey, 1910). According to DeBoer (2000) science curriculum has undergone a variety of changes throughout the past seven decades, fluctuating between using inquiry to assist with learning and stressing content, or knowledge memorization. Changes to science education practices were made as a direct result of the ever-changing nature of society and reflect what the populace deemed important at that given time (DeBoer, 2000; Dewey, 1910; Kennedy, 1998).

There are differing views as to what should be emphasized regarding science education. There are educators that see the focus of science education as needing to be competitive to other nationals. In contrast, another group of educators believe that the best practice for teaching science is to encourage science instruction in the form of inquiry: questioning, hypothesizing, testing, evaluating, analyzing and reporting (DeBoer, 2000; Chang & Mao, 1999; Lee & Songer, 2003; NRC, 2005; NSF, n.d.). However, despite all the changes to science education, students are choosing to advance in careers other than science (Millar, Osborne, & Nott, 1998). It is important to determine the effect of science reform instructional methods on student participation in and attitudes towards science education.

Several themes arose from the review of literature: previous changes to educational practices, descriptions of guided inquiry, how inquiry affects the students' participation in science, including journal writing and collaborative groups, and how inquiry affects the students' attitudes towards science.

Previous Changes to Educational Practices

Reform Efforts

In the last decade, reform efforts focused on spending more time and energy looking at science as a whole, and not on specific ideas (Millar, Osborne, & Nott, 1998; van Driel, Beijaard, & Verloop, 2001). Researchers have indicated that classroom teachers are changing their methodology so that students are engaged in cooperative groups and hands-on activities. However, there is question as to whether these changes are occurring on as large of a scale as indicated (Jablon & Van Sickle, 2003). For most teachers, reform is an unwelcomed occurrence because many are not comfortable teaching beyond basic fact memorization. In addition, it is important for educators to teach science so that all students are able to understand and learn (Linn, 1992; Millar, Osborne, & Nott, 1998; van Driel, Beijaard, & Verloop, 2001). Teachers have acknowledged the stance educational leaders are taking in regards to the implementation of inquiry science. However, teachers are overwhelmed by the large quantity of benchmarks and content they feel they must address (DeBoer, 2000). Many teachers are unwilling to change their teaching habits to accommodate this reform because they are comfortable with their teaching practices and have developed these practices with past experiences (van Driel, Beijaard, & Verloop, 2001). DeBoer (2000) and Millar, Osborne, and Nott (1998) state that the focus of science education should shift away from covering predetermined content and shift towards understanding and meaning.

According to a study conducted by Linn (1992), current reform efforts are geared towards acquiring more students to participate in science education in hopes of developing a more scientifically literate populace, as well as replenishing the workforce with educated workers. According to Kyle (1996), the policies that governed education in the 1950s-1960s have changed from a focus of social equality to that of creating a populace that is able to advance in industry. Various organizations have set out to create a body of standards to ensure the aforementioned goal, but have done so in error because they neglected to realize certain factors that play a role in whether or not a curriculum is accepted and implemented properly. Kennedy (1998) noted that there have been two different developed bodies of science teaching standards. She stated that both sets of standards, those from the American Association for the Advancement of Science (AAAS, 1993) and from the National Research Council (NRC) of the National Academy of Sciences (1996), have many similarities in regard to their expected teaching practices. Both groups encourage collaboration of students, exploring personal ideas or questions, and using evidence to support any findings. They differ in the area of focus. The AAAS emphasizes the actual act of conducting a scientific experiment, while the NRC emphasizes the need to stimulate the students into intellectual conversations regarding what they are learning. The difference between the two sets of standards is in essence what educational leaders have been debating. Should science education focus more on doing science or understanding scientific concepts (DeBoer, 2000)? Researchers have indicated that teaching to understand scientific concepts is more important than basic manipulation of materials (Linn, 1992; Millar, Osborne, & Nott, 1998; van Driel, Beijaard, & Verloop, 2001). Yet, if true change is to occur in education, teacher pedagogy must be altered (DeBoer, 2000; Millar, Osborne, & Nott, 1998).

The problem with common practice regarding science instruction is that many begin instruction with disconnected arbitrary facts (Dewey, 1910; Linn, 1992; Millar, Osborne & Nott, 1998; van Driel, Beijaard, & Verloop, 2001). The information does not seem real to the student and does not help them understand the world around them in a practical manner. Students learn these facts without understanding how these facts connect with the broader spectrum and how that information affects other areas of knowledge (Dewey, 1910; Kennedy, 1998; Lee & Songer, 2003; Linn, 1992). This problem is illuminated by students who are able to score quite well on multiple choice or true/false type questions, but are unable to apply what they know to scenario, short, or extended response questions. Additionally, many teachers follow the text with no regard to the manner in which the student thinks and develops scientific thought. Students learn information about science, but not how to look at things in a scientific manner (Dewey, 1910). Manipulating items in a laboratory is better than teaching from a textbook, but the experience may be isolated from any meaning, and therefore, is meaningless itself (Dewey, 1910; Linn, 1992; Millar, Osborne & Nott, 1998). Students must be given opportunities to observe science in its truest form where they can begin to create their own understanding of scientific thought, without being limited by rote activity (Dewey, 1910; Linn, 1992; Millar, Osborne, & Nott, 1998). Students fail to develop a natural sense of wonder about the world around them, and as a result, many students have shied away from the sciences in their education process or as a career choice (Millar, Osborne, & Nott, 1998). Additionally, these students are not prepared to fully understand the contributions that science makes to society and thus cannot make informed decisions regarding technological and scientific advances that affect our society so rapidly (Millar, Osborne, & Nott, 1998; van Driel, Beijaard, & Verloop, 2001).

Barriers to Educational Reform

Some teachers may be unwilling to change their teaching practices due to their lack of knowledge of subject content or confidence with other instructional approaches (van Driel, Beijaard, & Verloop, 2001). Many teachers rely on a more traditional approach to teaching science, which include lecture, notes, and memorization of facts (van Driel, Beijaard, & Verloop, 2001). For reform to be beneficial, teachers need to have a firm understanding of the intentions of the reform program, accept the stated beliefs, and integrate any new knowledge with their preexisting knowledge (van Driel, Beijaard, & Verloop, 2001). They must be given more time to develop the new curriculum and make it their own. Significant change must be done over longer periods of time (Linn, 1992; Millar, Osborne, & Nott, 1998).

The problem for many teachers is that inquiry requires extensive planning, implementation, and resources (Pearce, 1999). The outcome is not predictable and requires more extensive background knowledge of the content. Huber & Moore (2001) concluded that much of the available literature encourages teachers to use inquiry in their classrooms, yet does little to help them do so. Some teachers firmly believe in how they teach. Their style has been formulated by past experience, in and out of the classroom (Eick & Reed, 2002). Changing a teacher's belief system is needed in order to change their teaching practices (Haigh, France, & Forret, 2005; Yager, 1986). Taking ownership of instructional changes is needed in order to gain the full benefit from inquiry education.

There is evidence to support the position that the use of inquiry is beneficial to students to help them develop a greater understanding of scientific concepts (Dewey, 1910; Gerber, Cavallo, & Marek, 2001; Linn, 1992; Wee, Fast, Shepardson, Harbor, & Boone, 2004). Reiff (2002) concluded that pre-service teachers developed a greater understanding of what inquiry is after participating in her study. Each participant reflected upon their own teaching practices and the use of science inquiry in the classroom. Participants were surprised to see that their students gained much more than scientific information from the lessons they taught. Students began to develop their social skills and took a more active approach and ownership to their own education. Additionally, the participants better understood the fluid nature of the teacher's role and that the role changed dependent upon the needs of the students. Subsequently, the participants saw that planning for inquiry lessons involved more time. The benefits far outweighed the cost of extra time planning and resources needed to teach science inquiry lessons. The end result was that the participants had a firmer grasp and a deeper understanding of inquiry as a teaching methodology (Reiff, 2002). Teachers should be careful to avoid blending traditional expectations with inquiry instruction. Teachers need to change their beliefs and match their pedagogy with their practice prior to attempting to alter the beliefs of their students. Only then will their efforts be productive (Wee, Fast, Shepardson, Harbor, & Boone, 2004).

It comes as no surprise that beginning teachers have difficulty implementing a true inquiry-based approach (Huber & Moore, 2001). They use step-by-step instructional lessons with outlines and a pre-determined outcome (Huber & Moore, 2001). Students do not fully understand what learning occurred and the whys to following specified steps (Hodson, 1990; Jarvis & Pell, 2004). Research indicated that teachers maintained their current style of teaching despite professional development activities to restructure their pedagological beliefs (Jarvis & Pell, 2004; Wee, Fast, Shepardson, Harbor, & Boone, 2004). Pedagological changes require reflection upon current practices. It is critical to provide educators with additional support and scaffolding to help teachers welcome the necessary changes needed for effective inquiry instruction (Bonnstetter, 1998). Changes to pedagological beliefs take time to fully evolve and replace previous practice (Jarvis & Pell, 2004).

As stated previously, there have been many changes to the methodology and the pedagogy surrounding the teaching of science. The NRC (2005) and the NSF (n.d.) have published articles, books and journals advocating the use of inquiry in the science classroom. Both of these organizations view inquiry instruction as best practice and have published many pieces of literature to encourage and assist teachers with implementation of this science reform instructional method.

Descriptions of Inquiry in the Classroom

Many students began to learn science long before entering the formal educational environment of the school system. Unfortunately, educators tend to ignore the mode in which the students learned about scientific content prior to entering the educational system (Gerber, Cavallo, & Marek, 2001). Students' participation in investigations allowed them to see that the world of science is a rather complex entity and that many facets of it are entwined: research, planning, arguing, and communicating (Haigh, France, & Forret, 2005). Student participation and attitudes towards science does not automatically increase because they are involved in hands-on activities (Hodson, 1990). Based upon his research, Hodson (1990) found that hands-on activities can be used improperly and students are left confused as to what learning was to have occurred from participation in the activity. He concluded that student participation and attitudes towards science can be negatively impacted as a result (Hodson, 1990).

At the heart of an inquiry investigation is the question itself (Hapgood, Magnusson, & Sullivan Palincsar, 2004; Pearce, 1999). Students need an existing prior knowledge in order to effectively conduct an inquiry, which can be obtained through use of short science picture books (Eick & Reed, 2002; Pearce, 1999). Prior to conducting an investigation, students need to make sure they have a precise question. They need to understand why that question is important and how they are going to investigate to answer to that question. Additionally, students need to contemplate how they are going to record their data so that it is a comprehensible and accurate portrayal of their research (NRC, 2005). The research question guides the inquiry.

During inquiry, a key stage is reporting to the class. Students need to understand what they have researched, why it is important, what specific evidence they have to support their conclusions and that they will be held accountable by their peers for providing a detailed and accurate presentation (NRC, 2005). After the presentation, the class discusses its merits and any points that need clarification. Additionally, the class compares the presentation to previous presentations and the similarities and differences that exist, as well as any discrepancies that might have arisen. The teacher's role is to aid students in developing a deeper understanding of the content without being the provider of information. Assessment should be aligned with the instruction. That enables the teacher to see the advancements, if any, a student has made in his or her knowledge building. It also shows whether or not the student has mastered the specified goals and objectives of the investigation (NRC, 2005). Students need to be provided opportunities to use what they have just learned from their inquiry in a new context in order to see its application in a new scenario. This deepens their understanding and cements their new-found knowledge in their minds (NRC, 2005). In addition, students must have ample time to review their inquiry and reconstruct their thought processes and develop ownership of their inquiry (NRC, 2005; NSF, n.d.; Pearce, 1999). For inquiry to flourish in the classroom, the teacher must create an environment where student ideas are allowed and supported. Students need to feel that their ideas matter. Teachers should help guide their students into deeper understanding through questioning, investigating, and collaborating with their peers (NSF, n.d.).

Guided inquiry is a type of inquiry where the teacher assists the students in making decisions regarding the direction of their inquiry. Guided inquiry education causes students to work through conflict in their minds concerning their knowledge and experiences in order to develop deeper understanding of the science itself (Gerber, Cavallo, & Marek, 2001). Science inquiry instructional techniques generally involved students in gathering information, collecting and interpreting data, formulating hypotheses, and drawing logical conclusions (Chang & Mao, 1999; Lee & Songer, 2003; NRC, 2005; NSF, n.d.), as well as sharing their findings with others (Lee & Songer, 2003).

"Inquiry touches many aspects of the classroom-the role of the teacher, the level of student participation, how science investigation is conducted, the skills students develop that can be applied outside of the classroom, the arrangement of materials and the room, how students interact with each other and the teacher, and how students learn" (Reiff, 2002). Participation in an inquiry-based environment allowed students to see varied perspectives held by their peers and encouraged them to reflect upon their own thinking, the thinking of others, and the use of evidence to formulate their understanding (Gerber, Cavallo, & Marek, 2001; Kawasaki, Herrenkohl, & Yeary, 2004). Opportunities should be provided to students to help them determine what they are going to study. Students should be allowed the freedom to think outside the norm when looking for the answer, as well as learn from others through discussions and sharing (NRC, 2005). Reading information from a book provided students with second-hand information. Participation in inquiry experiences provided students with first-hand knowledge (NSF, n.d.). First-hand experiences enabled the student to follow a chain of understanding and see the links that exist between concepts. Rote memorization diminished the building of such links and limited long-term conceptual understanding (NRC, 2005; Pearce, 1999). It is important for teachers to listen to their students during the learning process to determine what they truly believe. This information can be utilized by the classroom teacher to further students' understanding.

To enable students to become reflective, critical thinkers, teachers should encourage them to work through their experiences in order to develop their thought processes (Jablon & van Sickle, 2003). Students need to understand science and its impact on our world, as well as be able to make determinations regarding technology and society. Additionally, science education should open the eyes of the students to the vast number of careers available in regards to science and technology, as well as provide them with the necessary skills to pursue such a career (Yager, 1986). Unfortunately, many students go on to further their education without fully understanding the "nature of scientific knowledge" (Kawasaki, Herrenkohl, & Yeary, 2004).

Student Participation in Science Education

Classroom Interactions

Participation in science inquiry education has been found to have positive effects on student engagement, retention of content, ability to create connections between concepts and improved language and literacy skills (NSF, n.d.). As adults, these students are able to provide a more educated voice when dealing with societal concerns (Gerber, Cavallo, & Marek, 2001). Marks (1995) stated that when using an inquiry-based approach a clear purpose must be evident, or students will disengage. The emphasis of the teaching methodology will be void. In addition, the topic of study must be authentic in nature in order to grasp students' attention and draw them into wanting to learn about that particular topic (Marks, 1995).

Kawasaki et al (2004) researched whether student involvement in classroom discussions and arguments regarding science content had an affect on their overall participation. The results indicated that more meaningful discussion emerged when students were given the opportunity to verbalize their thoughts (Kawasaki, Herrenkohl, & Yeary, 2004). Additionally, the students developed a deeper understanding for the science they were studying as evidenced in their level of questioning to each other. The researchers believe that young students can be introduced to scientific exploration methodologies. Doing so will provide students with a foundation that can be built upon as they progress through their education. Additional participation in this type of learning environment is necessary in order to help students develop their questioning and reasoning skills and progress to a more advanced cognitive level (Kawasaki, Herrenkohl, & Yeary, 2004).

Research has also been done to indicate whether an inquiry-based approach would benefit students with behavioral and learning disabilities. Shymansky and Penick (1981) conducted a study that specifically targeted students with behavioral disabilities. They wanted to determine if using an inquiry-based approach would be beneficial in promoting the desire to learn science. The students were separated into two groups. One group was highly structured with precise actions students had to follow. The teachers imposed consequences based upon student actions.

The second group was less structured and student directed. The teacher acted more as a facilitator and asked questions to guide students' thought processes. Both groups had the same materials and were studying the same topic. Results indicated that the student-directed group spent more time on task during their activities. They also needed less restrictive supervision and had fewer behavioral concerns. The researchers concluded that using an inquiry-based approach was beneficial for promoting participation in students with behavioral disabilities (Shymansky & Penick, 1981). Dalton, Morocco, Tivnan, and Mead (1997) conducted a study utilizing 172 students of which 33 were classified as learning disabled. The students were in the 3rd or 4th grade from urban and suburban schools. Students felt more at ease during the science lessons because they were provided the necessary scaffolding to be successful. This resulted in increased participation for all students, including those with learning disabilities (Dalton, Morocco, Tivnan, & Mead, 1997).

Journal Writing

One method to stimulate students' interest in science and help them voice their ideas is to incorporate the use of a science journal into the daily routine. There is debate as to the exact purpose of a science journal. One purpose is that the science journal can be used as a log to record experimental designs, results, analysis and conclusions (Shepardson & Britsch, 1997). A very different purpose is that the science journal is a place where students can reflect upon the day's activities, write questions they would like to explore, and work out areas of confusion that they need to address (Klentschy, 2005; Shepardon & Britsch, 1997). Science journals can encourage student participation by providing them a place to make sense of the science activities they conducted (Shepardson and Britsch, 2001).

Shepardson and Britsch (2001) concluded that student journals enabled the teacher to see student interest areas, as well as where additional assistance was needed. They found that the use of words and pictures helped students demonstrate their understanding. The journals also were beneficial in encouraging student participation. Klentschy (2005) believed that active, reflective learning is lost when science journals become nothing more than experiment data logs. Baxter, Bass, and Glasser (2001) stated that writing in a journal does not automatically demonstrate understanding, unless it includes hypotheses, problem solving and critical thinking.

Science journals can also be a window into the child's attitude toward science education. If a journal is written in a neat and organized fashion, it is indicative of a more positive attitude towards science than a journal written in a haphazard manner with disorganized pieces of information (Shepardson & Britsch, 1997). However, when viewing student journals in attempts to locate attitudinal information regarding science, a child that expresses a negative perception should not be penalized for their opinion, but should be encouraged to substantiate their feelings through adequate written and pictorial means (Shepardson & Britsch, 1997).

In this study, student journals were used in accordance with Shepardson and Britsch (1997) and Klentschy (2005). Students wrote about the daily activity in their journal. They also rated the lesson and provided a rationale for their choice. Students were able to ask questions if they were confused or make predictions about the outcome of their investigation. The journals provided the researcher with information regarding student attitude toward science.

Student Attitudes toward Science Education

Student attitudes regarding science education are heavily influenced, and sometimes determined, in the early years of education (Dewey, 1910). Students make certain judgments based upon how the teacher addressed the content and conveyed understanding (Kennedy, 1998). Unfortunately, many students created negative opinions regarding science (Kennedy, 1998; Linn, 1992), which include but are not limited to "impersonal, alienating, and irrelevant to real life" (Kennedy, 1998). Other students create opinions about science stating that science is relative only to the scientist and the situation and nothing is ever definite. A smaller groups of students viewed learning science as needing to "understand complicated ideas" (Linn, 1992).

As students progressed through their academic years, their enthusiasm for school and science diminished, especially for girls (Jarvis & Pell, 2004). Jarvis and Pell (2004) also reported that students stated science became easier as they got older. Inquiry is not merely doing an activity. It is about thinking, structuring, and supporting scientific claims with evidence (Gerber, Cavallo, & Marek, 2001). Students developed negative attitudes towards science inquiry when emphasis was placed on factual memorization, assessment, and proper completion of data logs (Watson, Swain, & McRobbie, 2004). Students need to be encouraged to work as a team and discuss what is taking place in their inquiry instead of checking to make sure they are following exact directions. Watson, Swain, and McRobbie (2004) commented on two teachers who used an inquiry approach in their classrooms. They failed to show the importance of the explanation of the results and the discussion needed to fully comprehend what had happened in the inquiry. Instead, students made claims without supporting evidence, filled out data logs without regards to what their data represented, and completely missed the purpose of the educational experience. Rather, the students saw the experience as just another routine abstract exercise. Therefore, teachers need to emphasize the collaborative nature of inquiry and that argumentation is part of the process in order to reap the intended results (Watson, Swain, & McRobbie, 2004).

Research by the National Research Council (2005) indicated that students typically see a scientist as the character in cartoons that is bald, working in a laboratory with little contact with the outside world. Students typically found science to be boring and repetitious. That is because they are not given the opportunity to use their imaginations and develop their own understanding (NRC, 2005). If students are encouraged to develop their own understanding, they may determine that science is not about memorization of terms and formulas, but that science is about collaborating with others and working through situations to find the best answer. However, one research study concluded that although students may have been instructed using a non-traditional approach focused on more inquiry-based learning, the students' attitudes towards science did not change from that classroom experience (Wee, Fast, Shepardson, Harbor, & Boone, 2004). They concluded that continued exposure to an inquiry-based approach would be necessary to assist students with developing a more positive attitude towards science education. Similar findings resulted from a study completed by Parker and Gerber (2000). They indicated a positive increase in student attitudes towards science. Parker and Gerber (2000) agreed that continued experience with a properly implemented program of inquiry would greatly benefit students in developing more positive attitudes towards science education and content.

Additional support for the use of inquiry-based instruction was found through research conducted by Chang and Mao (1999) and Gerber, Cavallo and Marek (2001). Chang and Mao (1999) indicated a positive difference was found in students taught with an inquiry-based approach in regards to knowledge-level understanding, participation and attitude towards science. Students exhibited greater ability to work collaboratively and discuss their findings in a meaningful manner using evidence to support their position through involvement in inquiry-based activities. The positive attitude may be attributed to the students feeling as though they were involved in real science, which helped them to create a deeper appreciation for the material (Chang & Mao, 1999). Likewise Gerber, Cavallo and Marek (2001) showed a positive increase in student attitudes when taught using an inquiry approach. The Alcohol, Drug Abuse, and Mental Health Administration in partnership with the National Institute of Health funded a project by the Science Education Partnership Award to develop a program called Summer Science Exploration Program (SSEP). The goal of the summer camp was to study students' attitudes in regards to science and science careers. Typically, students exhibited a decrease in their attitudes towards science and science careers when moving from middle school to high school. Student interviews indicated they would like to be taught with less lecturing and more time to investigate situations that are relevant to their lives. Many felt apprehensive towards participating in science class for fear of giving "the wrong answer" (Gerber, Cavallo, & Marek, 2001). Students did not feel they were supported in questioning and working through their thought processes in regular science classrooms. After they participated in the summer camp, students knew how to pose questions, develop experimentation techniques, and analyze and report their findings. Participation in the summer camp was beneficial in promoting a healthier attitude towards science and science careers because students were engaged in an inquiry based approach that had proper scaffolding and went beyond senseless manipulation of scientific equipment (Gerber, Cavallo, & Marek, 2001).

Kyle, Bonnstetter and Gadsden (1988), audited a school county to determine if using an inquiry-based approach would be beneficial in creating more positive attitudes towards science education. They concluded that the teacher's perspective of science and the manner in which they taught science had a great deal of influence on student attitudes. More positive student attitudes were found in students whose teacher had undergone an intensive summer program that assisted the teacher in implementing a more inquiry-based approach in their classrooms. These students found science to be more interesting, relevant and useful. This change in attitude can be partially attributed to the acceptance of the teachers towards student questions and curiosity. Student attitudes were drastically changed when the approach was inquiry-based and the teacher's attitude was more positive.

Summary

These research studies are evidence that students must feel as though what they are being asked to learn is of value to them, not just to the teachers, administration, and curriculum developers. Participation and attitudes of students increased when this basic need for understanding why was met. Students were lost during investigations as to what they were supposed to be learning from the experience. Clear, concise objectives assisted students with the concept of why and enabled them to see the value of what they were learning. Students need structure, freedom to investigate, and time in which to do so (Chang & Mao, 1999; Dewey, 1910; Kennedy, 1998; Lee & Songer, 2003; Linn, 1992, NRC, 2005). It is important to allow our students to develop their critical thinking skills in order help them make sense of basic science principles and encourage their participation in making decisions regarding scientific concepts.

As shown in the research, students' participation in and attitude towards science is affected by several factors. Students should be given opportunities to explore their ideas regarding scientific concepts and should formulate their own understanding regarding relationships that exist between these concepts. Students should be given ample time and support in order to properly conduct an investigation, which involves questioning, hypothesizing, researching, analyzing, and reporting that is beneficial in creating their knowledge and must be free of formulaic practices (Chang & Mao, 1999; Lee & Songer, 2003; NRC, 2005; NSF, n.d.; Schmidt, Gillen, Zollo & Stone, 2002). It is only then that students will begin to understand scientific concepts and how these concepts affect our daily lives.

Chapter 3 explained the methodology used throughout this study. It included a timeline for the study, the topics studied within that timeframe, teaching methods used in the classroom and data collection methods.

CHAPTER THREE: METHODOLOGY

The purpose of this study was to determine the effects of science reform instructional methods on third grade student participation in and attitudes towards science. Qualitative and quantitative data collection methods were used in this study. Data were collected using multiple sources: pre and post student surveys, student journals, participation log, and researcher reflection journal. This chapter outlined the design of the study and described the school setting, participants, instruments used for data collection, and the analysis of the data.

Design of Study

This study was designed to determine whether the use of science reform instructional methods had an effect on student participation in and attitudes towards science. The study was conducted over a twelve week period beginning in August 2006 and ending in November 2006. The study was conducted using action research. Action research is "systematic inquiry conducted by teachers, principals, school counselors, or other stakeholders in the teaching-learning environment, to gather information about the ways in which their particular schools operate, the teachers teach and the students learn" (Gay, Mills, & Airasian, 2006, p. 499). As indicated by the research questions, data was sought that would reflect whether use of science reform instructional methods would affect student participation in and attitude towards science.

Qualitative data collections were used throughout this study. Using qualitative measures enabled the researcher to have a better understanding of student's attitudes toward science inquiry. It allowed the students to describe why they chose their Likert scale score for the daily lessons and provided a window into their thought processes. Daily interactions with the students and written reflections enabled the researcher to see behavioral patterns and levels of participation beyond a scale score.

To establish credibility and trustworthiness of the data, multiple sources were triangulated: student surveys, student journals, participation log, and researcher reflection journal. Triangulation entails “the use of multiple methods, data collection strategies, and data sources in order to get a more complete picture of what is being studied and to cross-check information” (Gay, Mills & Airsian, 2006, p. 603). Triangulation enabled the researcher to analyze across data sources and determine emergent themes.

Setting

This study was conducted at a K-5 school in a central Florida county. This county consisted of 67 elementary schools. Approximately 54% of students received free or reduced lunch. The demographics breakdown of the school consists of 80% white, 4% black, 7% Hispanic, 7% bi-racial, and 2% Asian/Pacific Islander.

Classroom Setting

The researcher is one of four 3rd grade teachers whose combined student enrollment is 61. The demographics breakdown for 3rd grade consists of 80% white, 5% black, 6% Hispanic, 7% bi-racial, and 2% Asian/Pacific Islander. For this study, the researcher used the students in their particular classroom. The demographics breakdown for the participants consisted of 60% white, 10% black, 20% Hispanic, and 10% bi-racial. The student’s ages ranged between 7 years of age to 9 years of age with a mean of 8.4 years. At the beginning of the study, 13 of the students participated. During the research period, three students relocated. One student moved to a selfcontained classroom within the school. The other two students transferred to schools outside the district. The class received two additional students at different times during the research period. However, their data were not included in the research because they were not present for the entire research period. Of the original class, 10 students were included in the research data. Science was taught for 45 minutes each day. Data were collected for each lesson taught by the researcher.

Instruments

This action research study consisted of four data collection methods: participation log, researcher reflection journal, pre and post student science attitude surveys, and student journals. The purpose and justification for use of each instrument are described in this chapter.

Pre and Post Student Survey

Prior to obtaining any data and at the conclusion of the research period, students completed a science attitude survey. The survey was written by Charles Pearce, which was found in his book Nurturing Inquiry published in 1999 by the Heinemann Publishing**.** Permission was obtained from the author to use the survey. This survey measured students' attitudes towards how they preferred science to be taught, their level of interest in science, and what it means to be a scientist. There was no validity or reliability information provided by the author of the survey. The researcher aligned the survey items with the research questions. Survey questions 2, 5, 6, 10 and 18 align with research question #1. Survey questions 1, 3, 4, 7, 9, 11-16 and 19-20 align with research question #2. The Likert scale portion of the survey was used as published. No questions were altered prior to disbursement. A copy of the survey is included in the appendix (see Appendix A).

Student Journals

Students were asked to complete a teacher constructed daily journal sheet that included a Likert scale at the top which asked them to rate the daily lesson. Students were then asked to explain their rationale for their numerical choice. The explanation piece was included in efforts to fully understand the position of the child and to enable the researcher to have a clearer picture of the student's attitude toward the daily lesson. Mills reported that journals provided a "window into the student's world" (Mills, 2003, p. 67). A copy of the daily journal sheet is included in the appendix (see Appendix B).

Participation Log

The researcher completed a teacher constructed participation log (see Appendix C) that rated the level of participation for each child at 15 minute intervals. The ratings ranged from 5 to 0, with 5 indicating strong participation and 0 indicating no participation. The log also included an area for the researcher to include a rationale for the numerical assignments, the lesson title, the focus of the lesson, and the specific form of instruction being used for each 15 minute interval.

Researcher Reflection Journal

At the conclusion of each lesson, the researcher wrote in a reflection journal regarding the daily lesson. Information was included regarding the specific activity, the level of success, areas that needed improvement, student difficulties, notable student comments, and suggestions for future lessons.

Data Collection

The following section described the methods used for data collection and included a timeline for the research. An IRB application was submitted to the University of Central Florida and approved in July of 2006 (see Appendix D). A typed letter was submitted to the school's principal explaining the action research project and permission was granted to conduct the research in the classroom (see Appendix E). Additional approval was granted by the county, as well (see Appendix F). Parents received a letter asking for their consent for their child to participate in the research (see Appendix G). The letter outlined the research project and detailed the student involvement. Students were asked to sign an assent form (see Appendix H). The assent form was read and explained to them by their parents to remove any questions regarding coercion by the researcher. Parents and students understood that participation in the research was completely voluntary.

Procedure

The following outline is a brief overview of the topics studied during the research period. The topics chosen were determined by the curriculum guides provided by the county.

Third Grade Science Inquiry

I. Scientific Process
    A. Question
    B. Record Data
    C. Analyze Data
II. Application of Scientific Process
    A. Develop own inquiry

    B. Conduct own inquiry
    C. Explain results and scientific thinking

III. Environmental Explorations
    A. Soil composition
    B. Inhabitants of the soil

IV. Matter
    A. Physical Properties
    B. States of Matter
        1. solid
        2. liquid
        3. gas
        4. volume
        5. density
    C. How Matter Changes
        1. physical changes
            a. mixtures
            b. solutions
        2. chemical changes

V. Energy
    A. Energy Transfer through Food Consumption
        1. food chain
        2. food web
    B. Heat Energy
        1. thermal energy
        2. insulators and conductors
    C. Light Energy
        1. reflection
        2. refraction
    D. Sound Energy
        1. sound waves
        2. pitch

<u>Week 1</u>

The first day of the research period, students were given the attitudinal survey by Charles Pearce. Then, students were introduced to the scientific process and learned how to question, record data, analyze data, and discuss their findings with their peers. The researcher used a discrepant event which involved yeast, water, and sugar. The conclusion was not expected by the students. Students discussed what they saw within a group of four students and tried to determine what caused the discrepant event. Students were asked to write their observations and discussions in a science notebook. The notebook was utilized to help students learn how to organize and analyze their observations. Students reported back to the class the details of their group discussion and what conclusions had been drawn based upon prior knowledge, observations, and sharing of ideas. This was the first time most students had participated in an inquiry setting, so students were also learning how to become active participants in their learning process.

Week 2

Students were asked to use what they learned from the previous week regarding the scientific process to develop, conduct, and explain their own scientific experiment while being involved in a small group. The purpose was to help the students to think like a scientist and develop their own test to answer a question they constructed. Students were provided with materials and were not instructed on how to use the materials. The materials were vinegar, baking soda, measuring spoons, and a tall, clear container. Students recorded their procedures in their science notebook, including specific measurements. Groups conducted the experiment using equal measurements of each product. Students could not explain why the combination of baking soda and vinegar reacted. Students were brought to the computer lab and used a teacher-created webquest to conduct their research. Students recorded pertinent information in their science notebooks that they found while researching. Students shared their findings with a small group and compared their notes. Group discussions were shared with a class and recorded on a large sheet of tablet paper.

As a result of experimentation, research, and discussion, two questions emerged as students analyzed the data. One question was whether the results would change if one of the ingredients was increased or decreased in comparison to the second ingredient. Students tested that question, making sure to write their specific measurements in their science notebook in order to compare their results with others in the class.

The second student-generated question was in regards to applying the knowledge they had learned to a real-world scenario. During their research, students read that the combination of vinegar and baking soda created carbon dioxide, thus the creation of bubbles. They also learned that vinegar and baking soda could be used as a cleaning agent. Students created a paste with the vinegar and baking soda. They also created a solution with the materials. Students hypothesized which combination would clean better. They tested their hypotheses on student desks that had been stained with pencil graphite. Students determined that the paste was the better cleaning agent. Small group discussions then followed to discuss why the paste cleaned better than the solution. Students drew from their experimentation and research to help formulate their conclusions. Students returned to the large group and shared their discussions with the class. Discussion points were written on large tablet paper and discussed. All student data, analysis, and conclusions were recorded in a science notebook by each individual student.

Week 3

Students were provided an opportunity to explore their schoolyard in an attempt to apply what they knew about ecosystems and to see a connection between factual information and real life. Students took a small plastic cup and a gardening shovel outside. They were told to place some soil in their cup from anywhere in the schoolyard. Students had to dump out their cup on the sidewalk and sort through the soil, recording what they found in their science notebook. Students were free to work individually or in small groups. The activity was repeated the next day. Students were told to go to a different part of the schoolyard than they were in the previous day. Students recorded their observations in their science notebooks. Students were then asked to compare their findings from the two days and write about why they may have found something different. Students met in small groups and compared their findings. Some students had found trash in their cups and debated the significance and effects of littering. The class came together and discussed their findings and conclusions.

Week 4

We continued our study of the world around us by focusing on matter and the elements that comprise it. We began by having students describe matter using their five senses. All descriptions were written on tablet paper and displayed in the classroom. A discussion then followed regarding the properties of matter. Students took the words written on the tablet paper and sorted them into groups: how things look, feel, smell, taste, and sound. Students learned the attributes of the physical properties of matter.

We then discussed what types of matter existed. Students readily answered that matter is in three states: solid, liquid, and gas. They were asked to define a solid, a liquid, and a gas. Ideas were shared and written on tablet paper. Students got into small groups and tried to come up with scenarios to test the ideas provided. During discussion, one student stated that a solid is something that is hard and you cannot put your finger through it, but you can put your finger through a liquid. Another group member mentioned that if you hit it with your fist and it does not move, it is a solid. That group tried to find objects around the room that they knew were solids and tested their definition to determine if it held true for all solids. Students returned to the large group and discussed their conclusions. It was through the discussion and questioning of ideas that students were able to formulate a personal definition for the states of matter.

Having an idea of the states of matter, students were asked what matter is and why it can be different in each state. Students were given small trade books and worked in small groups to determine the answer to the questions. Students determined that particles and their connections were how matter is created and defined. Students added information to their working definitions of solids, liquids, and gases to include particles.

Week 5

Studies continued with learning about the world around us. Students used science magazines to find pictures of solids, liquids, and gases. Pictures were cut out and placed into a collage. Students wrote captions underneath pictures explaining why that particular picture was chosen.

Students were then given a plastic cup, water, and a rock. Students instinctively placed the rock into a cup of water. Students noticed that in doing so, the water level rose. A group discussion ensued in attempts to explain why the water level rose. Once the group discussion was over, students had a working knowledge of the word volume.

Stations were set all around the classroom with different scales in each station. Students were given the opportunity to choose items from the classroom and predict their weight. Students then tested their predictions by actually measuring the objects and recording their results. Weights were measured in grams and pounds. Students were also provided with yard sticks and a height indicator to predict, test, and record heights of various locations or people in the classroom.

Students were given vinegar, water, oil, food coloring, a measuring cup, and a large plastic container. They were also told that the activity would focus on density. Students poured vinegar, colored water, and food coloring into a large plastic container. Students observed as the liquids began to separate and form noticeable layers. Students discussed what they saw with their partner and tried to create a working definition of density. A group discussion followed and students shared their ideas. All ideas were written on tablet paper and discussed.

Using their knowledge from the previous activity, students were asked to test some of the written ideas using candy bars, a cup, and water. Students wrote their hypotheses into their science notebook with a rationale for their choice. Students then placed a miniature Milky Way, a 3 Musketeers, and a Snickers separately into a cup of water and timed how long it would take for the candy bar to sink to the bottom of the cup. Results were recorded in their science notebooks and groups discussed the significance of their results. As a result of the group discussions, a question was posed as to whether or not the results would change if the amount of water was changed. It was clear that the majority of students needed further clarification of density. A larger container was filled with water and the same three candy bars were dropped in at separate times and were observed for their sinking rate. The results were the same as with the smaller containers. A discussion followed, in which more students were beginning to understand density, but still needed more involvement with it to obtain a firmer grasp on the difficult concept.

Week 6

Studies continued with density. Students were given four containers of the same size and shape. The containers were filled with beans, oil, sand, or marbles. Students predicted which container had the greatest density and would sink the fastest. Students were split into two groups. Each group received one large container filled with water and the four tester containers. Students took turns dropping the containers in the water. Each group discussed their results and shared their discussion with the class. Students now had a working understanding that particles and how closely they are compacted in the matter determine density.

As a result of the discussions, the question arose whether the results would differ if salt water were used instead of fresh water. All experimentation thus far was conducted with fresh water. Students divided themselves into three groups. Large containers were filled with an equal amount of fresh water and salt water. Students dropped a fresh egg into each container and recorded their results. The test was repeated using a boiled egg. Results were recorded in science notebooks. A whole class demonstration was needed due to unexpected results. However, even that test was unsuccessful in showing that a fresh egg floats and a boiled egg sinks due to the change in density. Nevertheless, students were able to discuss and understand the concept of density in its simplest form.

Students had a working understanding of matter and its components. We used that knowledge to hypothesize what we would observe if we changed the state in which the matter existed. Students were split into three groups: inside, outside, and freezer. Students created cups of vinegar, oil, and water. Students were attempting to determine if the three liquids would respond to elements differently. Students observed their cups to determine if there was a change in volume, density, and weight. Students noticed that the water evaporated and froze more quickly than the vinegar and oil. They also noticed that the oil did not evaporate or freeze well at all. Students discussed the phenomena in their small groups. All observations were recorded in science notebooks.

Week 7

Students were given a small baggy of gummy bears, chocolate chips, and M&M's. They were told that the bag contained a mixture. Students were to discuss in their small groups what a mixture was. Ideas were written on a white board. Once the groups were finished discussing, ideas were shared in whole group and written on tablet paper. Students were encouraged to engage in a discussion with the presenting group if they disagreed with their idea. Definitions were written on the tablet paper that needed further investigation.

To test their definitions, students were given cups of trail mix, candy corn blend, chocolate chip Teddy Grams and natural applesauce. They were told that not all the items were a mixture. Students had to work together to determine which items were a mixture and provide a rationale for their choices. A large group discussion followed that resulted in a few of the student definitions being eliminated from the tablet paper. However, students still only believed that solids were used to make a mixture.

To help students broaden their understanding of mixtures, each student was given Kool-aid powder, water, and a small, clear plastic tub. Students mixed the water and the Kool-aid together. They were then asked if the liquid Kool-aid was a mixture. Based upon their previous activities, most students stated it was not. Using their idea that mixtures can be separated by hand or by using a tool, I asked them for the Kool-aid powder back. Students exclaimed that was impossible. However, after some debate, students decided to place some cups in the freezer, outside and inside the classroom to see which environment would remove the water from their cup. Students recorded their actions in their science notebook, as well as subsequent observations of the cups. At the end of the lessons, students realized that placing items in the freezer only changes the state of the matter. They also learned that while placing items inside the classroom to evaporate, placing them outside caused them to evaporate more quickly. A group discussion was held to explain why the cups outside evaporated more quickly that those inside the classroom. Students determined that the faster evaporation was a result of warmer temperatures outside.

<u>Week 8</u>

Extending their understanding of mixtures, we began discussing what changes can occur when items are mixed together. Current experience was that ingredients underwent only physical changes. Students were given trade books and read them in a small group to help explain the difference between physical and chemical changes. They then drew a picture that included matter changing and labeled each portion with an explanation of the change. Students shared their pictures with the whole group. Ideas concerning what caused a physical change and a chemical change were written on tablet paper.

Students then got into small groups again and read the directions on the back of a package of muffin mix. Students made muffins and observed the difference that occurred after baking. Students discussed with their group whether or not their muffins were a result of a physical or chemical change and wrote a rationale for their choice. All actions and conclusions were written in a science notebook. After the small group discussions, students shared their conclusions with the class.

For the following lesson, students used ingredients and made pizza. As they were eating it, they were discussing whether or not their pizza was a result of a physical or chemical change. Initially, most students stated that because it was cooked in the oven that it was a chemical change. However, one student stated that it was a physical change because they could remove the toppings they did not like with their hands. A discussion followed that resulted in a deeper understanding of physical and chemical changes.

Week 9

Students were provided opportunities to explore the various forms of energy that we come into contact on a daily basis. Students studied the transfer of energy through consumption of food and explored the interdependencies that exist between plants, animals, and man. Students were provided with a webquest and research questions. The first question asked them how energy was produced. The second question asked them how energy transferred from one organism to another. Students researched the production and transfer of energy between plants and animals in small groups or independently. Research was followed by sharing sessions where students discussed what they had read and helped each other create an understanding of the interdependency between plants and animals for survival.

After building their background knowledge of basic food chain and web construction, students were asked to pick one ecosystem that they would like to research further. All ecosystems were available through a webquest and students could explore as many as they would like before making their choice. Students recorded information regarding the interdependencies of the organisms they found in their ecosystem in their science notebook. Students shared the information they learned through pictorial representation with their classmates.

Week 10

Focus on energy moved to the production and transfer of heat energy. Students worked in a small group to discuss and record on a white board everything they think they knew about energy. Most ideas centered around food energy, being that we had studied it the week before. I was looking for any ideas that were different. Small groups shared their ideas with the class. All ideas were written on tablet paper, which was hung on the board. As we learned about heat energy, we added to the list or removed items if we found them to be unsupported.

Students were asked three questions regarding the transfer of heat energy. The objective was to help students understand that heat energy would transfer from the hotter object to the colder object when the two objects came in contact. Students had to work together using their science notebooks, their text, and various trade books around the room to answer the questions. After the groups were finished with the questions, answers to the questions were shared and discussed with the class.

Week 11

Students were given various pictures and were asked to sort the pictures into groups. The pictures were conductors and insulators. Students worked with a partner to sort and explain their rationale for their choices. Partner pairs shared their sorts and rationales with the class. Students then read a portion of the text that focused on conductors and insulators. After their reading, students could make adjustments to their sorts, if necessary.

Student pairs produced a picture of a campsite and the various ways that heat energy from a campfire could be used if there were no electricity. Students were encouraged to talk about their picture and be as creative as possible. Completed pictures were shared with the class. It was amazing to see how much the students understood solely on their pictorial representations. We then began to focus on the connection that exists between heat and light energy. We began by drawing shadows. Student pairs worked together to draw each other's shadow at three different times in the day. Once their drawings were complete, student pairs were asked to write a rationale as to why their shadows changed. Students realized that as the sun appeared higher in the sky, their shadows were shorter. A discussion followed as to why this occurred. By the end of the discussion, most students had a firm grasp on the concept of shadows and why shadows change in respect to light energy.

Continuing on with the shadow lesson, students were asked to explain why items through water appear broken. I wanted students to understand the concepts of reflection and refraction prior to being introduced to the vocabulary words. Ideas were shared in small groups and recorded on white boards. Ideas were then shared whole group and written on tablet paper. Students then read trade books to help clarify their understanding of reflection and refraction of light.

Week 12

To better help students understand light energy, its path, and its ability to reflect and refract, students were allowed to use any materials they chose to create a rainbow. Material options were transparent colored rulers, glass jars, water, magnifying glasses, plastic cups, and aluminum pie pans. Using a variety of materials, the students were able to create rainbows. Once they did, they were asked to write in their science notebook what materials they used and a rationale for why they were able to create a rainbow. A large group discussion followed where students were encouraged to share their methodology and their rationale. Students were able to see that the light had to be bent in order for a rainbow to occur.

We concluded the unit on energy by focusing on sound energy. We used instruments from the music teacher to demonstrate that sound travels. Either a high or low pitch was struck. The students had to indicate whether or not they were able to hear it. After each test, the students would take another step away from the instrument. We were trying to determine whether a high or low pitch would be able to be heard for a longer period of time.

A discussion followed the activity, which resulted in students questioning if sound traveled in a straight line as did light. Several students disagreed because of the activity we had just completed. One student wanted to retest the pitch activity, but this time she wanted students to count how long they heard each pitch. Also, instead of moving away from the instrument at even intervals, the students went to different locations in the schoolyard in attempts to support their idea that sound travels in many different directions at one time. A discussion followed the student-guided activity regarding why a fluctuating sound could be heard each time a note was struck. Students determined that sound traveled in waves and that it spread out from the source like ripples in a lake after a rock had been thrown in. Trade books were read to help clarify and confirm what the students had determined regarding sound energy.

Data Analysis

Data from this research study were triangulated to establish credibility and trustworthiness. The researcher triangulated across the data sources and determined common themes.

Student Surveys

The researcher administered the pre survey to the students and read each item aloud in a whole group setting. Each question was recorded on a spreadsheet and separated by pre survey and post survey responses. Indications of strongly agreed and agreed were averaged together to demonstrate a positive response to the question. Indications of disagreed or strongly disagreed were averaged together to demonstrate a negative response to the question. Averages were then compared to determine if there was a change in student attitudes from the pre survey to the post survey. However, for some questions when the change in attitude was small, the data was looked at per choice and not averaged together.

Student Journals

On the student journals was a Likert scale ranging from 5 to 1. On the bottom of the student journal was an area that students were to give a rationale for their Likert scale rating. The rationales were read to determine whether or not they coincided with the Likert rating. If a rationale did not match the Likert rating, it was indicated on a spreadsheet and compared to the researcher reflection journal and the participation log to determine if there may be any explanation for the conflicting data. Any explanation for the conflict was recorded on the spreadsheet. Conflicts were read again separately to determine if there was a common theme that emerged.

Participation Log

The analysis of the participation log was two-fold. It was used to determine the participation levels for each learning modality. It was also analyzed to determine the participation levels for each inquiry topic. Daily means were determined for each learning modality. The daily means were then averaged together to determine the mean score for the learning modality throughout the entire research period. To determine the participation level for each inquiry topic, student scale scores were compiled daily which indicated their total daily participation level. Good participation totals ranged from 12-20. This range was determined by the categories on the participation log. Good participation is a level 4. If students were to receive a 4 for all three observation periods, their total daily score would be a 12. Therefore, good participation ranges from 12-20. Moderate participation totals ranged from 6-11. Students would receive a moderate rating if they received ratings ranging from 4-2 on the participation log. Poor participation totals ranged from 0-5. Students would receive a poor rating if they received ratings ranging from 3-0 on the participation log that totaled no more than 5. Daily participation scores were recorded on a spreadsheet and percentages were determined for the ranges of good, moderate, and poor participation. The daily averages were then tallied together to find the mean participation level for each specific inquiry topic.

Researcher Reflection Journal

The researcher reflection journal was read and compared to the participation log and the student journals to find additional support for the information and to clarify any conflicts found in those data sources. The researcher reflection journal provided additional explanation for participation scores and provided a narrative of the events surrounding particular comments students made in their journals. It provided the researcher a clearer picture of the success or failure of a particular lesson and reasons for why some students may not have chosen to be as involved as they typically would have been.

Summary

Chapter 3 discussed the design of the study. It included a timeline that addressed the science concepts taught within the research period and how data were collected. The data related to how using science reform instructional methods affected 3rd grade students participation and attitudes towards science.

Chapter 4 discussed the analysis of the data and the themes that emerged from the analysis. It discussed the changes that occurred in student participation and attitudes towards science.

CHAPTER FOUR: ANALYSIS

This research study reported the effects of the use of science reform instructional methods on 10 third grade students' participation in and attitudes towards science. All the data pertaining to this study were collected over a 12 week period. Data collected were pre and post attitudinal surveys, student journals, a daily participation log, and a researcher reflection journal. This chapter discussed the themes which emerged from analysis of the data in relation to the research questions presented in chapter 1. Each theme is discussed in detail and aligned with the research questions.

How Use of Science Reform Instructional Methods Affected Student Participation

Question #1 – How did the use of science reform instructional methods affect student participation during science instruction?

Themes

Data for research question number one were collected through student pre and post surveys, a participation log, and a researcher reflection journal. The themes that emerged from the analysis were:

- Theme 1A-Student participation was greatest when using technology to research scientific concepts.
- Theme 1B-Students enjoyed working together in small groups to learn a new concept.
- Theme 1C-Student participation levels decreased when students were asked to participate in a whole group discussion regarding their learning.

Student Surveys

Participants were given a pre and post survey that analyzed their preferences for participation in science. Each response was based on a Likert scale with response choices of strongly agree, agree, disagree, and strongly disagree. Survey results were compiled in a spreadsheet to determine the averages for each question and answer choice. The same number of participants completed the pre and the post surveys.

Table 1: Student Responses to Participation Survey

Survey Question	**Pre Survey** SA	**A**	**D**	**SD**	**Percentage** SA/A	**Post Survey** SA	**A**	**D**	**SD**	**Percentage** SA/A
2. I learn best by reading chapters and answering questions.	5	2	2	1	70%	5	4	1	0	90%
5. When I talk things over with my partner I understand more about what I am learning.	9	0	1	0	90%	10	0	0	0	100%
6. I learn more when I work in a group and share ideas.	5	4	1	0	90%	7	3	0	0	100%
10. I like to discuss what I have discovered.	6	2	0	2	80%	9	1	0	0	90%
18. I can learn more by reading than by doing.	5	0	5	0	50%	1	4	4	1	50%

N=10

Results from the post survey showed an increase in student responses to #2, which states "I learn best by reading and answering questions" and a decrease for the number of students who strongly agree with #18, which states “I learn more by reading than by doing”. It is unclear as to why student answers to question #2 were more positive, being that this type of activity was rarely used during the research period. It may be linked back to what students expect from traditional science instruction and that they have not had enough exposure to inquiry science to restructure their beliefs. Results for question #18 may also indicate the struggle that still exists in the students’ minds as they evaluate their participation in inquiry in relation to their past experiences. Students’ present experiences may have assisted with their survey choice of doing an experiment. However, it is unclear as to whether or not students have a firm grasp on how they learn best.

Pre survey data for questions 5, 6, and 10 indicated that a small percentage of students did not think discussion of ideas and learning from each other were important. However, at the end of the research period, post survey data indicated that all students strongly agreed or agreed with survey items #5, #6 and #10. The students enjoyed being able to learn from each other and openly share their ideas.

Participation Log

The researcher completed a daily participation log for each student involved in the research. An observation was made every 15 minutes and a Likert scale score was used to indicate the level of participation for each individual child. The researcher input the participation scores into a Spreadsheet. The researcher determined the mean score for each learning modality, as well as for each participant. These means were then utilized to determine which learning modality and scientific topic yielded the most participation from the students.

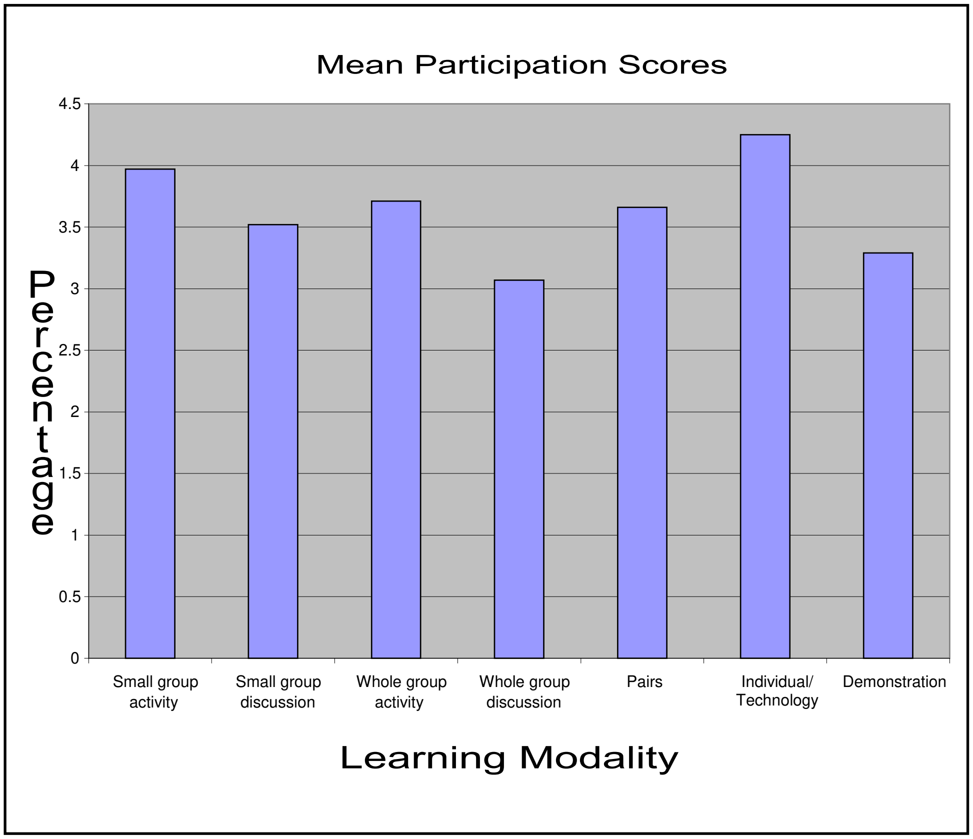

Figure 1: Mean Participation Scores

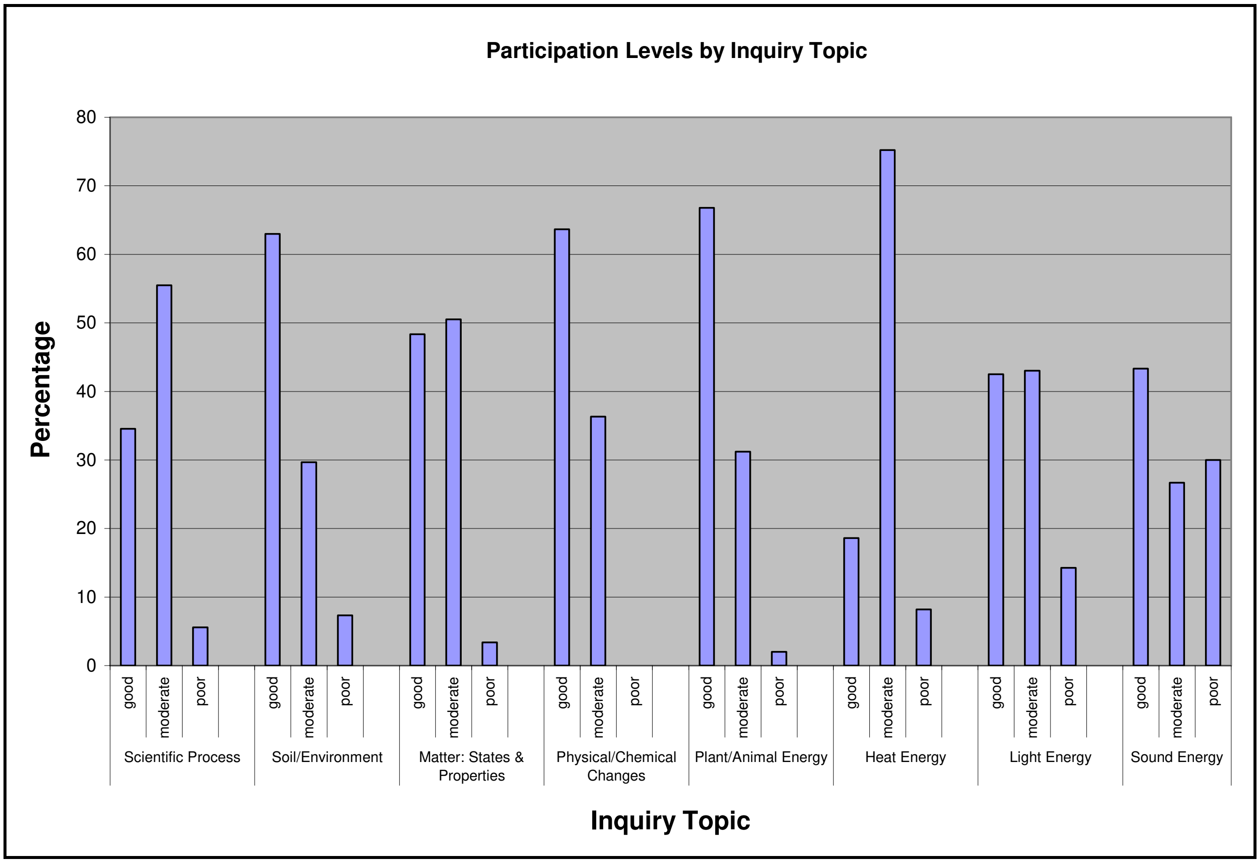

Figure 2: Participation Levels by Inquiry Topic

As indicated by Figure 1, student participation was the highest when independently utilizing technology and read-to-find research followed by small group activities. As noted in Figure 2, students had higher levels of good participation, as indicated by Likert scale scores of 5 or 4 on the participation log, when students learned about plant and animal energy, physical and chemical changes, and the environment. Poor participation occurred most often, as indicated by Likert scale scores of 1 or 0, when students learned about light and sound energy.

Researcher Reflection Journal

Throughout the research period, I wrote daily in a journal about which lessons were successful, which lessons needed to be adjusted, which students or groups participated well during the lesson and individualized questions and attitudes seen throughout the lesson. Students indicated that they thoroughly enjoyed going to the computer lab and using a webquest to find more information out about plants, animals and their interdependencies. One student made the following comment:

> "I love going to the computer lab and playing on the computer. It is much more fun than learning stuff from the book."

During class, students also indicated that they enjoyed being given the freedom to design their own experiments with materials and being able to discuss their thoughts and ideas with their small groups. Students typically came back to the whole group with a variety of ideas to share and were overeager to share them with the class. However, after they shared their ideas, participation levels dropped. This may be because students no longer felt involved in learning.

Summary of Question #1

The use of science reform instructional methods affected student participation in several ways. Students became more involved when they had to determine the answers to their own questions using technology or hands-on science materials. Students became more excited with what they were learning and were eager to share it with their peers in a small group setting. When students came back to the large group setting, student participation decreased. Student participation levels were higher when students made connections with the topic. Participation levels decreased when learning about more abstract scientific concepts, especially light and sound energy.

How Use of Science Reform Instructional Methods Affected Student Attitudes

Question #2 – How did the use of science reform instructional methods affect student attitudes towards science content and instruction?

Themes

Data for research question number two were collected through pre and post surveys, student journals, and a researcher reflection journal. The themes that emerged from the analysis are below.

- Theme 2A-Students enjoyed using technology to research scientific concepts.
- Theme 2B-Students enjoyed working together in small groups to learn a new concept.
- Theme 2C-Students enjoyed manipulating products to learn new concepts.
- Theme 2D-Student participation levels were higher when they connected with the topic.

Student Surveys

Participants were given a pre and post survey that included questions about their attitudes towards science. Each response was based on a Likert scale rating of strongly agree, agree, disagree, and strongly disagree. Survey results were compiled in a spreadsheet to determine the averages for each question and answer choice. The same 10 participants completed the pre and the post surveys. The following pages discuss the results for the survey items that relate to research question #2 on students' attitudes.

Table 2: Student Perceptions of Learning and Learning Science

Survey Question	**Pre Survey** SA	**A**	**D**	**SD**	**Percentage** SA/A	**Post Survey** SA	**A**	**D**	**SD**	**Percentage** SA/A
1. Learning is boring.	1	5	2	2	60%	1	0	2	7	10%
3. As I learn it is important to think about my thinking.	7	2	1	0	90%	8	2	0	0	100%
4. I learn more if I have a choice about what I will be learning.	7	2	1	0	90%	7	1	0	2	80%
11. Learning is finding out things that interest me.	5	5	0	0	100%	5	3	2	0	80%
20. Reading, math and social studies are all parts of science.	5	3	1	1	80%	8	2	0	0	100%

N=10

Questions #1, #3, #4, #11, and #20 all look at student perceptions of learning. Pre survey data for item #1indicated that 60% of students felt that learning was boring. Post survey data showed that only 10% of students felt learning was boring after the research period. Item #3 indicated that 90% of students felt it was important to think about their thinking while learning. Post survey data showed 100% agreed with item #3. For item #4, there was a slight decrease from 90% to 80% of students who agreed that they would learn more if they had a choice about what they were learning. Similar results were found for item #11. Item #20 showed a slight increase in the number of students who understood that learning science includes reading, math, and social studies.

Table 3: Student Perceptions of Teacher Assessment of Learning

Survey Question	**Pre Survey** SA	A	D	SD	**Percentage** SA/A	**Post Survey** SA	A	D	SD	**Percentage** SA/A
9. My teachers can measure my learning by reading my journal.	7	2	1	0	90%	5	4	1	0	90%

N=10

Due to there being no change in the strongly agree and agree average, data were delineated and attention were paid to each individual answer choice to determine if any changes occurred in student attitude regarding this particular question. Pre survey data indicated that 70% of students strongly agreed with the statement for #9, while 20% agreed and 10% disagreed. Post survey data indicated that 50% strongly agreed with this statement, 40% agreed, and 10% disagreed. It is uncertain why the students moved from strongly agreed to agreed being that journals were used on a daily basis to gauge learning and attitudes. However, students were not involved in the assessment of the journals which may account for the unexpected results.

Table 4: Student Perceptions of Discovering Answers in Science

Survey Question	**Pre Survey** SA	A	D	SD	**Percentage** SA/A	**Post Survey** SA	A	D	SD	**Percentage** SA/A
7. Discovering answers to my own questions is interesting.	2	5	1	2	70%	7	2	1	0	90%
19. Facts I discover on my own are more memorable than facts someone tells me.	4	5	0	1	90%	8	1	1	0	90%

N=10

Post survey data for item #7 indicated a positive increase in students who felt discovery was interesting. For item #19, more students indicated a rating of strongly agree to the statement that facts discovered independently were more memorable. Students may believe that facts they learned during those investigations are more memorable because they made a personal connection with the information and were actively involved in the construction of their understanding.

Table 5: Student Perceptions of Scientists

Survey Question	**Pre Survey** SA	A	D	SD	**Percentage** SA/A	**Post Survey** SA	A	D	SD	**Percentage** SA/A
12. Learning about science is only important for kids who want to become scientists.	1	3	2	4	40%	1	0	1	8	10%
13. I am a scientist.	5	2	1	2	70%	4	4	1	1	80%
15. Scientists ask questions.	5	4	1	0	90%	8	1	1	0	90%

N=10

Prior to the research period, students had a varied opinion about what a scientist is and the value of learning science. Post survey data for questions #12, 13, and 15 indicated that students have a better picture of what a scientist is and that questioning is a necessary facet of science.

Table 6: Student Perceptions of Science Picture Books vs. Textbooks

Survey Question	**Pre Survey** SA	A	D	SD	**Percentage** SA/A	**Post Survey** SA	A	D	SD	**Percentage** SA/A
14. I enjoy reading science picture books.	4	4	1	1	80%	5	5	0	0	100%
16. Science textbooks are the best books to read to learn about science.	5	4	1	0	90%	3	2	4	1	50%

N=10

Pre survey data for #14 and 16 indicated that students enjoyed reading picture books, but that textbooks were the most important books to read to learn science. Post survey data indicated that students saw the picture books and the trade books that were used during their inquiries as enjoyable resources.

Student Journals

Throughout the research period, students completed a daily journal that indicated their opinion regarding the daily lesson. Students included comments related to their science attitudes in those journals. Examples of their comments are included below. These comments indicated that students preferred activities that were engaging, hands-on and in a small group setting. Students felt they learned more when they had the opportunity to talk with classmates about what they were learning and receive feedback from their peers. The following quotations were from student journals and indicate the connections they were making between their prior knowledge and current experiences.

August 2006

“It was fun because we got to make it ourselves.”

“We finally got to do an experiment by ourselves, but with a partner, I mean and science is interesting and fun!”

“I greatly enjoyed science today because we got into groups.”

“I enjoyed science today because it was awesome and explosive and its action!”

“I greatly enjoyed science today because I made up the problem.”

October 2006

“I am greatly dissatisfied with today’s science because we had to write the whole time our observations. It was boring.”

“We drew pictures and wrote what we saw. I would prefer an experiment because I did not learn a lot.”

“Because it was so so fun and cool how me and Bob mixed the muffin cake and put the water in. It was gooey like chemical change, and I learned that baking is a chemical change.”

“We made pizza and we did it all by ourselves.”

“I greatly enjoyed science today because I love science and the computer lab. It is so much fun. I got to read and got to have a friend with me.”

Researcher Reflection Journal

During the research period, I completed a daily journal that indicated the daily lesson, the attitudes of students, and comments the students made regarding their learning. The journal also included notations of specific modalities that students indicated they preferred or opposed. Several examples of notations from the journal are below.

September 2006

"I can't believe this is science. When we first filled out our opinion on that paper you gave us, I marked that I am not a scientist, but now I know I am a scientist because I am doing all this stuff and learning from it. I am going to mark that the next time I get that paper again. At first I really didn't like science because we didn't do it that way in second grade, but I like it now more because we get to do stuff and it's fun!"

"We just did science? I can't believe it! It was so fun and I learned a lot! I've never done science like that before."

October 2006

"I am going to read this site. It has a lot of cool information on it. It even talks about an animal that doesn't exist anymore."

"I don't want to write anymore. It is so boring! I want to do something to learn!"

"Why can't we go on the computer? I liked reading about the animals! When do we get to go again? I don't want to do dumb stuff" (October, 2006).

The comments indicated that students wanted to be actively involved in their learning, not passive receivers of information. These comments also indicated positive student attitudes towards learning and collaborating in general.

Summary of Question #2

The use of science reform instructional methods affected student attitudes towards science in several ways. Students realized that learning science can be enjoyable. They also learned that science is not an isolated subject that is taught within a specified time period of the day. Science includes reading, math, and social studies. Students also began to realize that many books contain useful information in regards to developing their science understanding. Students enjoyed reading trade books and began reading them more often. Students learned that there will be times that they are asked to learn about a concept that may not appear to be of interest to them. Some students learned to enjoy content they had not enjoyed prior to the research period because of their involvement in the inquiry process. Overall, students felt that the time spent learning science through the inquiry process was beneficial and enjoyable.

CHAPTER 5: CONCLUSIONS

Purpose of Research

The purpose of this study was to determine the effects of using an inquiry-based science instructional method on student participation in and attitudes towards science. The twelve week long research period provided students with the opportunity to participate in small discussion groups, small activity groups, whole discussion groups, whole activity group, pairs, independent study and demonstrations. It also enabled the students to study a variety of science content, which included the scientific process, soil and the environment, states of matter, changes to matter, plant and animal energy, and heat, light and sound energy. Based upon the data collected using a pre and post attitudinal survey, student journals, a participation log, and a researcher reflection journal, the conclusions were that types of science reform instructional methods did have an effect on student participation in and attitudes towards science. Students enjoyed the use of technology and hands-on science tools. They also enjoyed working in pairs or small groups and enjoyed the ability to share their ideas with others and learn from their classmates. Further discussion of the conclusions for each research question and the limitations to this study were presented.

Question #1

Question #1 – How did the use of science reform instructional methods effect student participation during science instruction?

Question #1 was asked in order to understand if using science reform instructional methods would have an affect on student participation in science education. Data indicated that participation levels were dependent upon the specific science content that was being studied at the given time. When content was difficult for the students to connect to, especially heat, light, sound energy, students became disinterested and their participation levels declined. However, when students made connections with the content, or the content was of interest to them, their participation levels improved. Some student's participation levels changed within a scientific content area as the study progressed. These results are in agreement with Marks (1995) who stated that topics of study must be authentic to the students in order to draw their attention and foster the desire to learn.

Participation levels also fluctuated dependent upon the learning modality that was in use during a specific lesson. Students tended to participate more when they were using technology or in small collaborative groups. Many felt less threatened by the smaller number of participants and were more willing to share their ideas and opinions. On the contrary, when students were asked to participate in a whole group discussion and share with the entire class their findings, most student participation levels decreased. It appeared that many were not comfortable sharing their information with the entire class because they were not completely confident with their conclusions. This finding is in congruence with the results Kawasaki, Herrenkohl, and Yeary (2004). They concluded that participation levels increased when students were engaged in discussions and arguments regarding science content. They also stated that students will need repeated exposure to this type of learning environment in order to increase their comfort level and cognitive skills.

In conclusion, science reform instructional methods did have an effect on student participation in science. Student participation levels differed dependent upon the learning modality and the content being studied. Students preferred science content they were able to make personal connections with. However, some students began to enjoy learning about the more abstract scientific content when they were able to interact with it and begin to make connections to their prior knowledge.

Question #2

Question #2 – How did the use of science reform instructional methods affect student attitudes towards science content and instruction?

Question #2 was asked to understand if using science reform instructional methods would have an affect on student attitudes towards science. Data indicated that students enjoyed working in small collaborative groups, as well as with technology and hands-on equipment. This finding is supported by research conducted by Chang and Mao (1999) and Gerber, Cavallo, and Marek (2001) that showed a positive increase in student attitudes when involved in inquiry-based activities focused on collaboration and questioning. Students also began to see that books other than their textbook were sources of information and began to read them independently. Some students saw that science integrates many other areas of subject matter and is important to learn. This idea is supported by Charles Pearce in his publication entitled Nurturing Inquiry in1999.

There was a slight change in student attitudes when studying a specific area of content that was too abstract or difficult for them to understand. However, some students did develop more positive attitudes towards science content that they otherwise would not have found enjoyable prior to this research period.

In conclusion, students' attitudes towards science did improve. They preferred smaller group activities and discussions. Students commented on the ease of learning and their level of enjoyment when using technology, hands-on equipment and small collaborative groups because they became interactive with the content and students had someone to discuss their ideas with.

Limitations

There were limitations to this study. One limitation was the small sample size, which would not be representative of 3rd grade students in general. The original class size was 15 students, but 2 students chose not to participate and 3 students left the class prior to the conclusion of the research. New students entered the class, but were not included in the research because they were not present for the pre-survey. Additionally, student absences did affect the ability to complete certain activities, and choices regarding small group composition were limited due to the small sample size. Finally, the research was conducted only for a 12 week period and most students had not been exposed to an inquiry instructional method prior to entering the classroom. It took several weeks for the students to begin to understand how to work as a team and allow differing opinions and ideas to be shared. Therefore, application of results are limited to this study and cannot be used to make generalizations regarding 3rd grade students.

Conclusion

This study was conducted to determine the effects of using science reform instructional methods on student participation in and attitudes towards science education. The analysis of the data showed that student participation and attitudes did improve with use of science reform instruction methods. Students were more willing to participate and work together to learn difficult content.

This study did lend itself to additional research. Due to the small sample size, the shortened time for research, and the population, these research questions should be investigated with another group of students to enable me to make more definitive decisions regarding the methods to use in the classroom. If the research is conducted again using a different group of students, a larger population will be needed, as well as a lengthened period for research.

APPENDIX A: STUDENT SURVEY

Student Survey

Name ______________________________

Read each statement and circle the appropriate response.

SA: strongly agree A: agree D: disagree SD: strongly disagree N: no opinion

1. Learning is boring.	SA A D SD N
2. I learn best by reading chapters and answering questions.	SA A D SD N
3. As I learn, it is important to think about my thinking.	SA A D SD N
4. I learn more if I have a choice about what I will be learning.	SA A D SD N
5. When I talk things over with my partner I understand more about what I am learning.	SA A D SD N
6. I learn more when I work in a group and share ideas.	SA A D SD N
7. Discovering answers to my own questions is interesting.	SA A D SD N
8. The best way to measure learning is for my teacher to give tests.	SA A D SD N
9. My teacher can measure my learning by reading my journal.	SA A D SD N
10. I like to discuss what I have discovered.	SA A D SD N
11. Learning is finding out about things that interest me.	SA A D SD N
12. Learning about science is only important for kids who want to become scientists.	SA A D SD N
13. I am a scientist.	SA A D SD N
14. I enjoy reading science picture books.	SA A D SD N
15. A scientist asks questions.	SA A D SD N
16. Science textbooks are the best books to read to learn about science.	SA A D SD N
17. Scientists should answer old questions before asking new ones.	SA A D SD N
18. I can learn more by reading than by doing.	SA A D SD N
19. Facts I discover on my own are more memorable than facts someone tells me.	SA A D SD N
20. Reading, math, and social studies are all parts of science.	SA A D SD N

APPENDIX B: STUDENT JOURNAL

DATE:____________________

Topic being studied:____

Please circle the number beside how
you would rate today's science lesson.

5: greatly enjoyed
4: enjoyed
3: neutral
2: dissatisfied
1: greatly dissatisfied

Please explain *WHY* you chose your choice
and give specific examples in your writing.

APPENDIX C: PARTICIPATION LOG

Lesson Title	5 strong particpation	4 good particpation	3 moderate particpation	2 seldom particpation	1 rare particpation	0 no particpation	Focus	Date

Student Code Numbers	TIME: every 15 minutes			Observations information relative to the rating received
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
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24				
25				

APPENDIX D: IRB LETTER

University of Central Florida

Office of Research & Commercialization

July 3, 2006

Mrs. Heather Robinson
1248 Riverbreeze Boulevard
Ormond Beach, FL 32176

Dear Ms. Robinson:

With reference to your protocol #06-3594 entitled, **"The Use of Guided Inquiry and its Impact on Student Participation and Attitude Toward Science Instruction,"** I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 7/3/2006. The expiration date will be 7/2/2007.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator. **Please notify the IRB office when you have completed this research study.**

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

Barbara Ward

Barbara Ward
UCF IRB Coordinator
(FWA00000351 Exp. 5/13/07, IRB00001138)

Copies: IRB File

BW:jt

12201 Research Parkway • Suite 501 • Orlando, FL 32826-3246 • 407-823-3778 • Fax 407-823-3299

An Equal Opportunity and Affirmative Action Institution

Revised 09/05

UCF IRB Addendum/Modification Request Form

This addendum form does NOT extend the IRB approval period or replace the Continuing Review form for renewal of the study.

INSTRUCTIONS: Please complete the upper portion of this form and attach all revised/new consent forms, altered data collection instruments, and/or any other documents that have been updated. **The proposed changes on the revised documents must be clearly indicated by using bold print, highlighting, or any other method of visible indication. Attach a highlighted and a clean copy of each revised form.** This Addendum/Modification Request Form may be emailed to IRB@mail.ucf.edu or mailed to the IRB Office: ATTN: IRB Coordinator, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or campus mail 32816-0150. Phone: 407-823-2901 or 407-882-2276, Fax: 407-823-3299.

- **DATE OF ADDENDUM:** 3-12-07 to IRB #06-3594 IRB Addendum # 4334
- **PROJECT TITLE:** The use of guided inquiry and its impact on student participation and attitude toward science instruction.
- **PRINCIPAL INVESTIGATOR:** Heather Robinson
- **MAILING ADDRESS:** 1248 Riverbreeze Blvd. Ormond Beach, FL 32176
- **PHONE NUMBER & EMAIL ADDRESS:** 386-212-0362 harobins@volusia.k12.fl.us
- **REASON FOR ADDENDUM/MODIFICATION:** I changed the title and the focus of my questions to better match the direction of my literature review and the specific area I wished to research.
- **DESCRIPTION OF WHAT YOU WANT TO ADD OR MODIFY:**

I wish to change my original project title from the one stated above to the following:

> The use of science reform instructional methods and their effect on 3rd grade student's participation and attitude toward science.

I wish to change question #1 to read as follows:

> Did the use of science reform instructional methods affect student participation during science instruction?

I wish to change question #2 to read as follows:

> Did the use of science reform instructional methods affect student attitudes towards science content and instruction?

SECTION BELOW - FOR UCF IRB USE ONLY

X Approved ____ Disapproved | Tracy L Dietz — IRB Chair Signature | 3/22/07 — Date

____ Full Board X Chair Expedited | ________ IRB Member/Designated Reviewer | ________ Date

1

APPENDIX E: SCHOOL SITE LETTER

June 26, 2006

To Whom It May Concern:

Heather Robinson is a third grade teacher and has requested permission to conduct an action research project with her class for the 2006-2007 academic year. I understand that she will be using a guided-inquiry approach that entails the use of questioning and investigations to enable students to create deeper conceptual understanding of scientific concepts. She will be assessing the students' attitudes prior to their participation in the inquiry-based approach, as well as at the end of her research. She will also be monitoring their level of participation throughout the lessons. It is her goal to determine whether student attitudes and levels of participation change as a result of their involvement in the guided-inquiry science class. I fully support her efforts and will provide any additional assistance that may be needed for Heather to complete this research as required for her master's degree course work.

Sincerely,

John E. Cash
Principal

APPENDIX F: COUNTY LETTER

August 24, 2006

Ms. Heather Robinson

Dear Ms. Robinson:

I have received your request to conduct research I understand you will be conducting research on "The use of guided inquiry and its impact on student participating and attitude toward science instruction." I am approving your request to conduct this study with your third grade students However, please keep in mind that the final decision to participate in your study will be at the discretion of your principal, and by parent permission for each student participating.

By copy of this letter, you may contact your principal and work out any arrangements for participation, data collection and confidentiality. We request that you conduct your study with as little disruption to the instructional day as possible.

I would appreciate receiving a copy of your project at the completion of your study.

Sincerely,

Chris J. Colwell

Chris J. Colwell, Deputy Superintendent
Instructional Services

APPENDIX G: PARENT CONSENT

Dear Parent or Guardian,

My name is Heather Robinson and I am your child's third grade teacher this year. I am currently engaged in my Master's Program at the University of Central Florida, and will be writing my thesis on the inclusion of the guided inquiry teaching method and its impact on student participation and attitude toward science content. My thesis is based on the research in which your child could be a participant.

I am requesting your permission to interview, observe, audiotape and videotape your child in order to obtain the information I need to become a more effective science educator. All information will be kept confidential. There will be no personal identification of the students in regards to their responses, and the videotape will only be viewed by me and my advisory team.

Mr. Cash is aware of this research study and has given approval. All records will be destroyed at the conclusion of the study. Your child stands to benefit from this study with the possibility of developing a greater desire to learn science and a better understanding of how science is vital to many aspects of our daily lives.

In order for your son/daughter to participate, I need a written release. Please fill out the form below and indicate whether you are giving permission for your R.J. Longstreet student to participate or if you are denying permission.

I would like to thank you for your help with this matter. If you have any questions, please feel free to contact me at (386) 756-7280 ext 33752. Also, research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (IRB). Questions or concerns about research participants' rights may also be directed to the UCF IRB office, University of Central Florida, Office of Research & Commercialization, University Towers, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246, or by campus mail 32816-0150. The hours of operation are 8:00 am until 5:00 pm, Monday through Friday except on University of Central Florida official holidays. The telephone number is (407) 823-2901.

Sincerely,

Heather Robinson

I have read the procedure described above. I voluntarily agree to participate in the procedure, and I have received a copy of this description.

I, ______________________________ have read and understand the letter for participation in the "How does the use of the science inquiry instructional method affect student participation and attitude towards science content and instruction?" research study.

_____ Yes, I give permission to my child to participate.

_____ No, I do not want my child to participate.

______________________________ ______________

Parent Signature Date

APPENDIX H: STUDENT ASSENT

Student Assent Form

I am doing a research project on third graders and the use of science investigations on their attitude and participation in science class. I am interested in how students like you learn and grow in their thinking and discussing science. I am conducting this research as part of my studies at the University of Central Florida.

You will be asked to complete a survey at the beginning of this study, as well as at the end. Also, I would like to video tape you during science time when you will be working in cooperative learning groups. Only Dr. Gresham, my professor at UCF, and I will see the video tapes. I will destroy the tapes at the end of the study. All names will be changed so that nobody will know it was you in my study. It will not affect your grade if you decide you don't want to do this. You can stop participating at any time. If you don't want to be video taped, you will still participate in all the class activities and discussions. You just won't be included in the video taping. You will not be paid for doing this. Would you like to take part in this research project?

____ I want to participate in Mrs. Robinson's research project.

______________________________ ______

Student's Signature Date

____

Student's Printed Name

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