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Cultivating the Environmental Awareness of Third Graders through Inquiry Based Ecopedagogy: Impact on Students' Achievement and Attitudes

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CULTIVATING THE ENVIRONMENTAL AWARENESS OF THIRD GRADERS THROUGH INQUIRY BASED ECOPEDAGOGY: IMPACT ON STUDENTS' ACHIEVEMENT AND ATTITUDES

by

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ABSTRACT

The purpose of this study was to assess the impact on third grade students' achievement and attitudes when integrating an inquiry-based learning with a technology-based public service announcement component into a pollution, recycling, and conservation unit of instruction. The epistemological theoretical frameworks for this study were inquiry-based learning, ecopedagogy, and technology. Forty third grade students participated in the mixed method action research study. A control group (N=19) was taught using the science textbook lesson and activities. An experimental group (N=21) was taught using the four strands of science learning practices. Quantitative data collected were pre-test and post test content, attitude, and public service announcement rubric scores. Pre-test and post-test content and attitude data were analyzed using analysis of covariance (ANCOVA). Experimental group content mean total and domain mean scores were significantly higher than control group mean scores. Qualitative data collected consisted of student interviews. Transcripts from interviews with students in the experimental and control groups were coded and analyzed. Transcript analyses found that the students in both groups recognized pollution, conservation, and recycling problems. Students from the control group had difficulty remembering vocabulary words from the pollution, conservation, and recycling unit. Students in the experimental group believed that their public service announcements would change people's attitudes about pollution, conservation, and recycling. Based on the findings, inquiry-based learning with a public service announcement provided students with a holistic and self-directed process to understand the environmental concepts. Implications of these findings are also discussed.

INDEX WORDS: Inquiry base learning, Science attitudes, Environmental education, Ecopedagogy

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DEDICATION

This dissertation is dedicated to my family. My mother, Linda, and my father, Jim, who have provided love, support, words of encouragement throughout my life, and inspiring me to carry out all my dreams. To my brother, Drew, thank you for reminding me to laugh and have fun no matter what. . . I'm ready to travel. To Kay, thank you for inspiring us with your courage and strength. You have shown us that positivity can make any situation better or conqueror any obstacle even cancer. Hopefully, one of these future scientists will find a cure. To Mike, you are the backbone of our family and you always remind us to laugh. It is the best cure! I love you all.

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CHAPTER 1

INTRODUCTION

"Computer can thereby enable people to actively participate in the production of culture, ranging from dialogue and debate on social and ecological issues to the creation expression of their sustainability organizations and movements"

-Kahn, 2010, pp. 74-75

Our planet is being inundated with waste due to the world's growing population. It is our duty as stewards of this planet to find solutions for our waste problems. The U.S. Environmental Protection Agency reports that our solid waste generation has increased from 3.66 pounds per person per day in 1980 to 4.34 pounds per person per day in 2009 (Environmental Protection Agency, 2012). Americans are only recycling about 1.51 pounds per person per day (Environmental Protection Agency, 2010). This means that 2.83 pounds of trash per person per day are eventually ending up in our landfills around the United States. Our students must be taught to be stewards for the environment and the time is now before it's too late. With the growing world population and the increased waste generated by one person, our planet will be covered with waste if we are not careful.

The U.S. Environmental Protection Agency (EPA) established a division in 1971, the North American Association for Environmental Education (NAAEE), to promote better stewardship of the environment. NAAEE was instrumental in defining the term 'environmental education.' NAAEE defines environmental education as, "Environmental education (EE) teaches children and adults how to learn about and investigate their environment and to make intelligent, informed decisions about how they can take care of it" (Environmental Education and Training Partnership, 2010). NAAEE also provides assistance to environmental educators and teachers in North American (North American Association for Environmental Education, 2012).

The Environmental Education Alliance of Georgia (EEA) has supported environmental education programs by offering grants and a variety of educational programs throughout Georgia since 1992. Its mission is to promote a culture of environmental stewardship. EEA is the state equivalent of the North American Association for Environmental Education. EEA sponsors an annual conference for educators and naturalists called the Outdoor Learning Symposium. Environmental Education Alliance of Georgia also has over 87 different types of environmental grants for teachers of elementary students (Environmental Education Alliance of Georgia, 2010). The primary focus for all the environmental education and grant programs is to assist teachers with the Georgia Performance Standards along with finding innovative methods to teach the standards.

The Georgia Department of Education's Georgia Performance Standards for Science requires K-12 educators to address environmental concerns at third grade and high school levels along with integrating technology when teaching the standards. In third grade, the environmental standards are focused on recycling, conservation, and pollution. These standards are designed so that students investigate the effects of pollution on plants and animals, conservation of our resources, and recycling of different materials (Georgia Department of Education, 2007). Successful implementation of the Georgia Performance Standards requires students to identify solutions for environmental issues as well as compels students to be more mindful of their responsibility on our planet.

Attitudes towards science affect the way students apply and develop their understanding of scientific concepts in the classroom (Fishbein & Ajzen, 1975). Attitude is defined as

> affective or evaluative in nature, and that it is determined by the person's beliefs about the attitude object. Most people hold both positive and negative beliefs about an object, and attitudes is viewed as corresponding to the total affect associated with their beliefs. (Fishbein & Ajzen, 1975, p. 14)

Students start school with positive attitudes toward science, however, their positive attitudes lessen during their elementary school years (Pell & Jarvis, 2001). Kahle posited that the students' lack of understanding of scientific concepts is a contributing factor in the development of negative science attitudes (Kahle & Lakes, 1983). Changes in negative attitudes are difficult since these attitudes are directly linked to personal, social, and cognitive factors (Koballa, 1989). Classrooms where teachers encouraged students to think and explore scientific concepts promoted positive attitudes about science (Nolen, 2003).

Inquiry-based learning provides students with a problem solving approach to explore scientific concepts. Inquiry-Based Learning is

> a multifaceted activity that involves observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers,

explanations, and predictions; and communicating the results. (National Research Council, 1996, p. 23)

Using this definition, the National Research Council (NRC) posited a process for students to increase their scientific knowledge, which is known as the four strands of science learning practice. The four strands of science learning practices are: (1) understanding scientific explanations; (2) generating scientific evidence; (3) reflecting on science knowledge; and (4) participating productively in science (NRC, 2007).

Ecopedagogy is a way for children to connect to nature to critically examine environmental problems (Grigorov, 2012). It is based on the work of Paulo Freire's (1970) *Pedagogy of the Oppressed*, which calls for learners to use dialogue that will lead to action from their experiences (Rainforest Action Network, 2009). Gaard writes, "Ecopedagogy articulates a commitment to the coherence between theory and practice, along with a reluctance to pursue texts, scholarship, and activities that lead away from the goal of putting theory into action" (Gaard, 2008, p. 19). Ecopedagogy encourages conversation and political action to find solutions about global environmental concerns. It also enables individuals to develop skills and strategies to foster responsible environmental action along with encouraging individuals to live a more sustainable lifestyle (Grigorov, 2012). Environmental education provides individuals with awareness of environment issues and how our actions affect our planet. Critically examination of ecopedagogy combined with environmental education standards encourage individuals to use their voices to investigate and plan solutions for pollution, conservation, and recycling.

Technology is everywhere. Today's third grade students must master different types of technologies (e.g., iPods, iPads, netbooks, or computers) since technology is an integral part of our everyday lives. Teachers are currently utilizing different types of technology such as cameras, Interactive Whiteboards, netbooks, and clickers to reach their students. In some schools, the iPad and/or the iPod touch are inspiring students and teachers to research and investigate global issues. Research has found that technology is a useful educational tool in the classroom (Chandler & Swartzentruber, 2011; Mutisya & Baker, 2011; Naquin et al., 2010). Technology supports scientific exploration especially in the area of environmental education and it should be available to advance all students' learning (Barwin, 2009; Chang, Tzung-Shi, & Wei-Hsiang, 2011; Rocas, Gonzalez, & Araujo, 2009; Shanely, 2006). The purpose of this study was to investigate how integrating inquiry-based learning and a technology component of a public service announcement into a pollution, recycling, and conservation unit impacted students' environmental achievement and attitudes.

Theoretical Framework

This study used an epistemological theoretical framework to reflect on the intervention of inquiry based learning, ecopedagogy, and technology to answer the research questions. Inquiry-based learning provided the study with the framework for the students to question, collect data or evidence, explain their evidence, connect scientific knowledge, and communicate their knowledge about environmental issues along with a social component embedded in the development of a public service announcement. Ecopedagogy provided a philosophical framework to critically examine and discuss environmental concerns. Technology provided students with a device to research environmental topics and to produce their public service announcements. The methodological theoretical framework is mixed methods. Each theoretical framework will be discussed in more detail in Chapter 2.

Personal Rationale

This project will always remain near and dear to my heart. A grandparent on both sides of my family modeled and voiced their opinions about the importance of protecting our planet. When I was growing up, my maternal grandmother was a woman ahead of her time. She composted and recycled items to keep them out of the landfills. She believed that composting would give the plants she grew a better, richer soil than the clay found in Georgia. Her guidance groomed three horticulturists. One is currently providing the planet with sustainable trees to cut down on the amount of pollutants in our air. My paternal grandfather was a Native American who always stressed importance of protecting Mother Earth. We would spend hours nurturing plants and observing nature along with great conversations about ways of saving our resources. These memories are a great legacy to pass onto my third grade students. As a third grade teacher, I have always tried to inspire my students to become protectors of the planet and instill in them a sense of responsibility about environmental practices. However, one of the best ways to encourage this guardianship is to couple environmental concerns with technology. It is my hope that this study demonstrated to students that technology can impact how individuals view concerns about pollution, recycling, and conservation.

Purpose of the Study

The purpose of this study was to investigate how integrating inquiry-based learning with a technology component of a public service announcement into a pollution, recycling, and conservation unit impacted students' environmental achievement and attitudes. Technology is currently in our classrooms and all around us. Teachers are using Interactive Whiteboard (IWBs), computers, netbooks, iPads, clickers, flips cameras, cameras, and programs, such as Photo Story, iMovie, ThingLink, and Movie Maker, to improve instruction. Technology is a useful instructional tool in the classroom for teaching science and/or environmental standards (Barwin, 2009; Bosseler, 2005; Chang et al., 2011; Hickey et al., 2002Rocas et al.; 2009; Shanely, 2006;).

Research suggests environmental education fosters stewardship among the participants (Chandler & Swartzentruber, 2011; Conde & Sanchez, 2010; Naquin et al., 2010; Riordan & Klein, 2010). John Dewey (1958) wrote, "When consciousness is connected with nature, the mystery becomes a luminous revelation of the operative interpenetration in nature of the efficient and fulfilling" (p. 353).

Research Questions

The overarching research question for this study was:

> What was the impact on third grade students' achievement and attitudes when integrating inquiry-based learning with a technology-based public service announcement component in a pollution, conservation, and recycling unit?

To answer the overarching questions, two sub-questions were investigated:

1. Are there differences between third grade students' achievement scores as a result of using inquiry-based learning when teaching the pollution, conservation, and recycling unit?
2. Do third grade students' attitudes about pollution, conservation, and recycling change as a result of using inquiry-based learning?

Significance of the Study

With accountability being the primary focus in the current educational system model, research has shown that traditional lecturing and use of textbooks is not a successful practice for educating students (Langer, 1997). Consequently, inquiry-based learning will help students construct their knowledge to think critically and then identify solutions to many environmental concerns. Langer (1997) posited, “Studies have confirmed that science is better taught through hands-on research and discovery than through memorization alone” (p. 72). The goal of this study was to advance the existing knowledge about environmental education, inquiry based learning, and the teaching of science in elementary schools. Findings will be of interest to several groups.

This research will be of interest to science educators since it should add to the existing literature about the process of inquiry-based learning within the field of science. This study will be of interest to curriculum developers because it looked at the impact of enhancing traditional science instruction using lecturing, textbooks, and science workbooks. The research will be of interest to elementary school teachers since it looked at how third grade students master standards without the use of a science textbook to find solution to a variety of environmental problems through the use of inquiry-based learning. Environmental education organizations will be interested in this study since the environmental standards were used to build environmental stewardship while students investigated real-life environmental problems. It would provide for funding opportunities for future environmental projects for teachers and students. This study was significant since it provided additional evidence about how inquiry-based learning and technology affected third grade students’ understanding about the environment.

Limitations of the Study

There are three limitations of this study. First, the study was completed during a very restrictive time frame of approximately 14 days. Due to curriculum guides and time constraint from the state, this limited the amount of time provided to cover the environmental standards in the classroom. Inquiry-based learning and ecopedagogy requires time for students to critically examine a topic and find solutions. Second, the student participants were not randomly selected since they were assigned by the administrative staff from the school. This instance might make it difficult to generalize the findings of this study in other locations. Third, the researcher was the instructor.

Definition of Terms

Air Pollution - Harmful gases in the air caused by smoke from cars, trucks, and factories (Harcourt School Publishers, 2009).

Attitudes - “affective or evaluative in nature, and that it is determined by the person’s beliefs about the attitudes object. Most people hold both positive and negative beliefs about an object, and attitudes is viewed as corresponding to the total affect associated with their beliefs” (Fishbein & Ajzen, 1975, p. 14).

Conservation - The saving of resources by using them wisely (Harcourt School Publishers, 2009, p. 340).

Early Intervention Program - Early Invention Program or EIP is a federal program for children functioning below grade level in reading and/or math.

Ecopedagogy - “Ecopedagogy articulates a commitment to the coherence between theory and practice, along with a reluctance to pursue texts, scholarship, and activities that lead away from the goal of putting theory into action” (Gaard, 2008, p. 19).

Environmental Education - Teaches children to investigate and make informed decision on how to care for the planet (North American Association for Environmental Education, 2012).

Inquiry-Based Learning - “multifaceted activity that involves observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results” (National Research Council, 1996, p 23).

Land Pollution - Land that is contaminated by wastes such as litter, toxic waste, etc (Harcourt School Publishers, 2009).

Natural Resource - “A material that is found in nature and that is used by living things” (Harcourt School Publishers, 2009, p. 314).

Nonrenewable Resource - “A resource that, when it is used up, will not exist again during one’s human lifetime” (Harcourt School Publishers, 2009, p. 318).

Science Learning - Four strands of science learning which include:
(1) understanding scientific explanations; (2) generating scientific evidence; (3) reflecting on scientific knowledge; and (4) participating productively in science (NRC, 2007).

Pollution - "Harmful material that is added to the environment" (Harcourt School Publishers, 2009, p. 328).

Recycle - To reuse a resource by breaking it down and making a new product (Harcourt School Publishers, 2009, p. 343).

Reduce - To use less of a resource (Harcourt School Publishers, 2009, p. 342).

Renewable Resource - "A resource that can be replaced quickly" (Harcourt School Publishers, 2009, p. 316).

Reuse - "To use a resource again and again" (Harcourt School Publishers, 2009, p. 343).

Water Pollution - Undesirable harmful change in the water due to chemical or unnatural changes (Harcourt School Publishers, 2009).

Summary

Environmental concerns are increasing due to pollution growth and the amount of trash individuals produce daily. Currently, in Georgia, educational standards at the third grade level require students to study pollution, conservation, and recycling. Environmental education in our schools provides students with an outlet to discuss environmental issues that concern them locally as well as globally. Technology can provide students with a vehicle to express their solutions. Inquiry-based learning, ecopedagogy, and technology epistemological frameworks can also provide students an opportunity to critically examine an environmental problem and devise solutions. This study explored the impact on third grade students' achievement and attitudes when integrating inquiry-based learning with a service announcement component in an environment unit.

CHAPTER 2

REVIEW OF THE LITERATURE

"Technology is a mode of revealing. Technology come
to presence in the realm where revealing and
unconcealment take place, where aletheia, truth, happens"
-Heidegger, 1977, p. 13

This chapter reviews the literature and research pertaining to the topics of inquiry-based learning, environmental education, ecopedagogy, attitudes, and technology.

Theoretical Framework

This study used an epistemological theoretical framework to reflect on the intervention of inquiry based learning, ecopedagogy, and technology to answer the research questions. Inquiry-based learning provided the study with the process of inquiry for students to build evidence of knowledge through social interactions. Ecopedagogy posits a philosophical framework to critically discuss environmental concerns. Technology was a tool to research and organize information. These structures combined to form a mechanism to determine to identify environmental solutions for pollution, conservation, and recycling.

Inquiry-Based Learning

Students inquire and question the unknown in order to understand what they are learning, especially in the subject area of science. The inquiry process allows students to observe, ask questions, research, think critically, and plan scientific investigations to understand scientific concepts (Llewellyn, 2002). Inquiry-based learning has grown and developed out of John Dewey's philosophical belief that education begins with the learner's curiosity about their surroundings. In the 1960s, Joseph Schwab (1961) expanded the ideas of inquiry and Robert Karplus' (1964) learning cycle further defined the process of inquiry. Later, the definition of scientific literacy and standardization helped to change the inquiry process to focus on four strands of science learning.

Inquiry-based learning is based on John Dewey's premise that students learn through experimenting and observing the world around them. Dewey (1938) believed that "every experience should do something to prepare a person for later experiences of a deeper and more expansive quality. That is the very meaning of growth, continuity, reconstruction of experience" (p. 47). Children need the freedom to question their surroundings through scientific discovery and problem solving. Dewey (2001) posited that a child's social interactions and imagination gives them the power to understand and explore. John Dewey explained the scientific method to be used in the classroom: identifying a problem, defining that problem, collecting data, formulating and testing a hypothesis, drawing conclusion, and generalizing the conclusion to new situations. Students who are actively engaged in schoolwork seem to have a greater understanding of scientific concepts (Dewey, 2001).

Joseph Schwab (1961) expanded inquiry concepts into the field of science when he stated

> treatment of science as inquiry consists of treatment of scientific knowledge in terms of its origins in the united activities of the human mind and hand which produce it, it is a means for clarifying and illuminating science knowledge. (p. 102)

Joseph Schwab (1961) referred to this type of knowledge as "stable inquiry and fluid inquiry" (p. 15). Schwab (1961) defined stable inquiry as the consistent whole body of knowledge or subject matter while fluid inquiry is permitting new knowledge to be discovered.

The idea that learning and understanding is constantly changing when new information is developed through a process of intellectual development and reasoning. Robert Karplus, a physics professor at the University of California -Berkeley, further developed this process he created the learning cycle. After visiting his daughter's second grade classroom, Karplus noticed that students needed a process for investigating and exploring scientific concepts. The learning cycle he created is based on Piaget's three stages of cognitive equilibration to acquire new knowledge (Atkin & Black, 2003). Piaget (1971) posited that, "To know an object is to act upon it and transform it, in order to grasp the mechanisms of that transformation as they function in connection with the transformative action themselves" (p. 29). The first stage of cognitive development occurs when the learner assimilates their experience into what they learned from a prior encounter. In the second stage of the learning cycle, the learner finds contradictions in what they encountered with their previous knowledge of the subject. In the final stage of the learning cycle, the learner must accommodate this new information (Piaget, 1971). Karplus' (1964) three learning cycle phases are exploration, invention, and expansion of the idea. In exploration, students try to understand the new concepts they have been introduced to during science instruction by the teacher. Students are expected to ask questions about the new concepts. During the invention phase, students focus on explaining the new knowledge with the help of the teacher. In the expansion of the idea or application phase, the students practice the new idea so that it will become stabilized (Karplus, 1964). A learner explores his/her surroundings by allowing new stimuli to enter and shape the information into new understanding and knowledge of the experience. Roger Bybee revised the learning cycle to include five steps: (1) Engagement; (2) Exploration; (3) Explanation; (4) Elaboration; and (5) Evaluation. The first step of engagement is where the learner focuses on the topic, makes connections to what they know, and ask questions. During the exploration step, students have hands-on experiences with the topic and collect data. During the explanation step, the students use the data to find solutions for the problem. In the elaboration step, students receive new information to apply to what they have learned to extend the knowledge on the topic. In the evaluation step, students evaluate what they have learned (Bybee, 1997; Bybee et al., 2006; Layman, Ochoa, & Heikkinen, 1996).

Science inquiry-based learning methods and learning cycles were researched and disseminated to educators; however, further studies revealed that students were learning facts in isolation without ever achieving understanding and problem solving skills (National Research Council, 2000). During the late 1980s and 1990s, *Benchmarks for Science Literacy* (1993) from the American Association for the Advancement of Science (AAAS) outlined a plan for the schools to achieve scientific adult literacy in science. This would allow students to experience inquiry-based methods to critically examine science content area. Moss, Rock, and Koehler (2007) stated, “Scientific literacy customarily refers to making the most science understandings through the course of one’s life through informed decision-making underpinned by an appreciation for the complex relationships between the institute of science and society at large” (p. 237). People must have a working knowledge of scientific principles to make informed decisions about scientific issues that affect society. For scientific literacy to occur, educators in conjunction with scientists decided to create a science practice or framework along with standards to address these concerns. National Research Council (2000) stated, “Standards treated inquiry as both a learning goal and as a teaching method” (p. 18). The science practices would foster skills that people use every day, like problem solving, creativity, critical thinking, working cooperatively with others, using technology, and becoming life-long learners. The science standards emphasize understanding of scientific concepts and developing inquiry (Layman et al., 1996).

For students in kindergarten through fourth grade, the standards provide meaning and directions in their scientific investigation (National Academy of Science, 1996). Inquiry-based learning nurtures students’ natural curiosity. Layman et al. (1996) stated, “Students work together as a community of learners: the teacher ensures that they listen to each other with respect, reflect and build on one another’s ideas, demand evidence to support opinions, assist each other in drawing conclusions” (p. 39).

The National Research Council (1996) defines inquiry as,

> a multifaceted activity that involves observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. (p. 23)

The National Research Council (2000) reinforced their definition and ideas of inquiry by noting there are five essential elements of classroom inquiry applicable to all grade levels:

1. Learners are engaged by scientifically oriented questions.

2. Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
3. Learners formulate explanations from evidence to address scientifically oriented questions.
4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
5. Learners communicate and justify their proposed explanations. (p. 25).

These elements initiate a practice for exploring and learning different scientific concepts while developing a profound understanding (National Research Council, 2000). Students are afforded with a process for thinking and reasoning by asking questions, planning and conducting an investigation, using appropriate tools, and thinking logically about the relationship between evidence, explanations, and communicating scientific arguments with classmates (Bybee, 1997).

In 2007, the National Research Council published *Taking Science to School and Teaching Science in Grades K-8* to discuss research regarding the gaps in science education. A committee recommendation was to teach students inquiry methods interwoven with the standards as a framework, as opposed to teaching the two separately, so that students would be able to achieve scientific proficiency and knowledge. The National Research Council (2007) created four strands of science learning practices: (1) understanding scientific explanations; (2) generating scientific evidence; (3) reflecting on science knowledge; and (4) participating productively in science. Table 1 shows the four strands for science practices and their explanations.

Table 1

Four Strands of Science Learning Practices and their Explanations

Strands	Explanations
Understanding scientific explanations	Students define and use scientific concepts to connect their understandings of the natural world.
Generating scientific evidence	Students generate and evaluate evidence by collecting, organizing, and interpreting data to defend arguments.
Reflecting on science knowledge	Students work toward understanding, reflecting on, and revising new scientific knowledge that can be revised as new evidence emerges.
Participating productively in science	Students participate in the classroom scientific learning community to communicate productive ways of representing ideas and interpretations of the data.

For the understanding scientific explanations strand, students define and use scientific concepts to connect their understandings of the natural world. Students build on their prior scientific knowledge to assimilate the new information. During the generating scientific evidence strand**,** students generate and evaluate evidence by collecting, organizing, and interpreting data to defend arguments. Students use the data collected to develop their understanding of the scientific evidence. During the reflecting on science knowledge strand, students work toward understanding, reflecting on, and revising new scientific knowledge that can be revised even further as new evidence emerges. In the last strand of participating productively in science, students participate in the classroom scientific learning community to communicate productive ways of representing ideas and interpretations of the data. When science is practiced, it involves participating and practicing the inquiry learning process to understand the standards until proficiency is achieved (NRC, 2007). Michaels, Shouse, and Schweingruber (2008) stated that "conceptual understanding of natural system is linked to the ability to develop or evaluate knowledge claims, carry out empirical investigation, and develop explanations" (p. 34).

For this study, the researcher used the National Research Council's inquiry process of four strands of science learning as the basis for creating the inquiry-based unit of instruction. The researcher's inquiry unit development process was similar to the learning cycle created by Robert Karplus (1964) and Roger Bybee (1997). The students broke down the standards for pollution, conservation, and recycling to understand the scientific explanations. The standards used for this study were the current Georgia Performance Standards. The Next Generation Science Standards had not been adopted by the state of Georgia at the time of the study. Next, students researched topics with their netbooks to generate scientific evidence. Then, students used their researched information to write a script, create a setting, and edit the script to reflect on their scientific knowledge. After reflecting on the scientific data they gathered, the students decided that a public service announcement was a good way to productively communicate their ideas and interpretations of that data. This also afforded the students to discuss and consistently reflect on what they have learned. The four strands of science practices supplied the students with the process for inquiry to support their investigation. Table 2 shows how unit design mapped to National Research Council' four strands of science learning practices.

Table 2

Four Strands of Science Learning Practices and Our Learning Cycle

Strands	Our Learning Cycling
Understanding scientific explanations	Breaking down of the standards for pollution, conservation, and recycling
Generating scientific evidence	Research topics of pollution, conservation, and recycling on the netbooks or computers
Reflecting on science knowledge	Using information from the research to write a script, create setting(s), and edit scripts
Participating productively in science	Produced the public service announcements for pollution, conservation, and recycling

Inquiry-Based Learning Research

Inquiry-based learning creates an environment of discovery and knowledge for students to explore. These studies supplied students with strategies to improve their understanding of scientific concepts. Inquiry-based learning was introduced in classrooms using a creative drama strategy (Hendrix, Eick, & Shannon, 2012), to motivate children with different learning styles (Tuan et al., 2005), and in a traditional third grade classroom (Harris, 2009).

Hendrix et al. (2012) conducted a quantitative study to determine if integrating a creative drama activity component in an inquiry-based elementary science program, Full Option Science System (FOSS), helped students understand physics of sound and solar energy concepts. Thirty-eight fourth and fifth grade students in the treatment group participated in an action research study for the teacher researcher to investigate if creative drama activities made a difference in science learning and attitudes. Hendrix et al. administrated a pre-test and post-test using the Full Option Science System module test to determine differences in learning outcomes and a shortened version of Three Dimension Elementary Science Attitude Survey to document changes in student's attitudes towards science. Data were analyzed by using a $2 \times 2 \times (2)$ Mixed ANOVA to determine the differences in the attitudes and learning outcomes between the drama (or experimental group) and the non-drama (or control group). Hendrix et al. found ($F= 160.2$, $p < 0.001$) significantly higher gains for the fourth grade drama experimental group and ($F = 14.3$, $p < 0.001$) significantly higher gains for the fifth grade drama experimental group. However, there was no significant difference in the students' attitudes towards science ($F = 7.5$, $p < 0.01$). A creative drama strategy in an inquiry based science unit increased conceptual science learning.

Minogue, Madden, Bedward, Wiebe, and Carter (2010) conducted a mixed method, multiple-case study to investigate elementary school science teachers' practices using the National Research Council's four strands of science learning and their students' actions. The study included five teachers and 342 students in grades kindergarten through fifth. The teachers implemented the use of a science notebook and different instructional strategies into the four strand of science learning inquiry process. The data collected for the study were from direct observations, student notebooks, and interviews along with a data sheet with an outline of the lesson, instructional practices, and use of science notebooks in pre, during-, and post-investigation activities. Data were coded and transformed from qualitative to quantitative data through the use of triangulation. Minogue et al. (2010) found that students' understanding of scientific concepts improved when they were engaged in activities that developed the four strands of science learning practices along with the use of a science notebook to reflect on what they were learning.

Harris (2009) conducted a quantitative research study to examine the difference between the third grade achievement scores using traditional science strategies and inquiry-based science strategies. The experimental groups used inquiry-based strategies where students: (1) were given a question; (2) made an observation; (3) collected data; and (4) made a hypothesis for solving a real world problem. The control group used the third grade science textbook and workbook. Data collected by the school system created scores and the Georgia Criterion-Referenced Competency Test (CRCT) scores. Data were analyzed by using paired t-Test and ANOVA to determine difference in the inquiry-based instructional strategies and the traditional science instruction for third grade students. Harris found both groups significantly increased their mean scores from the pretests to the posttests. However, the experimental group scored significantly higher on posttest than the control group for unit 1 [$t(12) = 8.79$, $p < .01$] and on unit 2 [$t(12) = 9.40$, $p < .01$]. Harris concluded that the results of the study demonstrated the effectiveness of inquiry-based learning science strategies in third grade classrooms.

Tuan, Chin, Tsai, and Cheng (2005) conducted a mixed-methods research study that involved 484 eighth grade students to determine if students with different learning styles were motivated after inquiry-based learning strategies in science were implemented. The control group used the physical science textbook and the experimental group conducted experiments, made predictions, wrote their responses, and had discussion about what they learned. Data collected students' motivation toward a science learning questionnaire (SMTSL) and was used before and after the ten-week science units (light, heat, and temperature, force and buoyancy, and mixture and compounds) were taught for students in the experimental (n = 254 students) and control groups (n = 232 students). At the beginning of the study, students in the experimental group filled out a learning preference questionnaire to identify their learning style. Then 40 students from the experimental group were selected to participate in a post-test interview. Interviews were analyzed by using a paired *t* -test, MANOVA among the four learning styles in SMTSL. Tuan et al. found there were significant differences between the students' motivation using inquiry learning strategies ($p < .001$) compared to the students in traditional science instruction.

Overall, these research studies found that interventions that utilize inquiry-based learning increase students' understanding of science (Harris, 2009; Tuan et al., 2005). The four strands for science learning practices along with the science notebooks do supply students with a process to explore and understand scientific concepts (Hendrix et al., 2012). For this study, inquiry-based learning was used for environmental learning. More specifically, it provided students with time to share their ideas for improving environmental problems for pollution, conservation, and recycling.

Environmental Education

The first definition of environmental education is attributed to William Stapp from 1969. Stapp and colleagues (1969) stated, "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to solve these problems, and motivated to work towards their solution" (p. 34). In 1970, the United States Congress passed the Environmental Quality Education Act. As a result of its passage, the United States Office of Education developed its own definition for environmental education. The United States Office of Education's definition states that

> environmental education means the educational process dealing with [man's] relationship with [his] natural and manmade surroundings, and includes the relationship of population, conservation, transportation, technology, and urban and regional planning to the total human environment. (Environmental Education and Training Partnership, 1997)

The Environmental Quality Education Act promoted environmental awareness through educational programs.

Concepts from both definitions were used when the current national standards were developed by the National Research Council of the National Academy of Sciences in 1996. Georgia had not adopted new standards at the time of defense of this dissertation. The National Academy of Sciences has standards to address different areas of science education and instruction in grades kindergarten through high school. The standards are Professional Development for Teacher of Science, Science Teaching Standards, and Science Content Standards. Physical Science, Life Science, Space Science, Science and Technology, and Personal and Social Perspective are the Science Content Standards specifically designed for students (National Academy of Sciences, 1996). Environmental standards are housed within the Personal and Social Perspective category. They are concerned with environmental consequences. The Personal and Social Perspectives National Standards for kindergarten through fourth grades provide students an opportunity to act on personal and social issues as they relate to the environment. The standards include (1) personal health, (2) characteristics and changes in populations,

(3) types of resources, (4) changes in environments, and (5) science and technology in local challenges (National Academy of Sciences, 1996). All environmental standards' topics afford students the opportunity to investigate environmental concerns in their community and the world. For the purposes of this study, the standard areas of types of resources and changes in the environment in the Personal and Social Perspectives National Standards apply to third grade science standards for Georgia.

Georgia Performance Standards, or GPS (2007), are the science standards that drive instruction in the state of Georgia. In Georgia, environmental standards are integrated in third grade and at the high school level. The third grade Georgia Performance Standards are based on the National Academy of Science's Personal and Social Perspectives Standards which focus on the areas of types of resources and changes in the environment. The science Georgia Performance Standards that apply to this study are:

> S3L2. Students will recognize the effects of pollution and humans on the environment.
>
> a. Explain the effects of pollution (such as littering) to the habitats of plants and animals.
>
> b. Identify ways to protect the environment.
>
> - Conservation of resources
> - Recycling of materials

Today, national organizations such as North American Association for Environmental Education (NAAEE) and the U.S. Environmental Protection Agency (EPA) provide funds through grant opportunities as well as professional learning for educators to address the standards for environmental education. The motivation behind these organizations is to foster an environment of stewardship among our children and schools as well as advocating the creation of environmental solutions. State organizations like the Environmental Education Alliance of Georgia (EEA) have afforded teachers with professional learning opportunities to improve environmental instruction in the classroom through more hands-on learning techniques with programs such as Project Wild, Project Wet, and Project Learning Tree.

Ecopedagogy

Ecopedagogy combines the ideas of environmental education with our mutual dependency on one another and other species while critically questioning environmental issues (Kahn, 2010). Ecopedagogy "articulates a commitment to the coherence between theory and practice, along with a reluctance to pursue texts, scholarship, and activities that lead away from the goal of putting theory into action" (Gaard, 2008, p. 19). It embraces the critical pedagogy theories created by Paulo Freire to identify solutions for environmental issues with dialogue (Kahn, 2010). Freire (2000) stated, "The act of knowing involves a dialectical movement that goes from action to reflection and from reflection upon action to a new action" (p. 21). Freire posited that schools would be the best place to critically study environmental problems. Freire (1970) stated, "Problems – posing education bases itself on creativity and stimulates true reflection and action upon reality, thereby responding to vocation of men beings who are authentic only when engaged in inquiry and creative transformation" (p. 70). Ecopedagogy provides individuals with a voice to spark political action by questioning the effects of pollution, the importance of recycling products, and reasons for conserving our natural resources

(Jardine, 2000). Jardine (2000) explained, “Exploring this ‘ecopedagogical’ relationship will shed light on an underlying ‘turning around’ of our understanding of ourselves and our place on the Earth required by a truly whole, integrated curriculum” (p. 172). We are forever linked to the Earth. However, through the chaos of our everyday lives, we have forgotten our dependency to our planet and its needs. David Jardine (2000) stated, “Ecology reminds us that the earth is a living system constituted by a vast interweaving and interconnected web of dependencies. To live well in the earth is to live in and with these dependencies” (p. 54). Ecopedagogy allows awareness, didactic scrutiny, and reflection of our current environmental issues.

For this study, students identified and researched environmental problems and shared what they learned with their fellow students. Students also worked as individuals to create solutions to the different problems. Public service announcements served as a vehicle for the students to present their newly constructed knowledge to others, which is a main component of most environmental education programs and the basis of ecopedagogical understanding.

Environmental Education Research

The literature in this section consists of research on environmental education. Implementation of environmental programs requires planning, examining, and evaluation to be successful (Conde & Sanchez, 2010; Riordan & Klein, 2010). Research also suggests environmental education creates and fosters stewardship among students when participants are actively engaged (Shanely, 2006). Students need to explore nature to find solutions for environmental problems and technology is a tool that can improve understanding of concepts.

Riordan and Klein (2010) conducted a qualitative study to determine what impact environmental learning in Expeditionary Learning Schools (EL) had on two middle school science teachers. Expeditionary Learning Schools use the inquiry-based approach embedded in John Dewey’s ideas. This case study used observations, field logs, and interviews to determine how two teachers incorporated environmental inquiry learning into their classrooms. Data were analyzed by triangulating codes using Atlas ti to identify the categories of the data. Riordan and Klein found teachers that used more inquiry-based learning problem-solving techniques and encouraged student interaction with the environment increased their student’s understanding and connection to the world.

Conde and Sanchez (2010) conducted a mixed-methods action research study of the “Ecocentros” program to evaluate the integration of environmental education in classrooms in Spain. The action research techniques of choosing a topic, creating a plan of action, evaluating the results of the plan, and reflecting on the results helped to evaluate and assess the integration of “Ecocentros” program. Data from interviews, discussions, observation, field notes, and video/audio recordings were collected and analyzed by coding, calculating the frequency and spatial, temporal, and personal diversity triangulation. Conde and Sanchez found dialogue and discussion between stakeholders was an essential component for integrating environmental education into the classroom and that, without it, change would not occur.

Shanely (2006) conducted a qualitative study with four sixth-graders involved in an outdoor education program where students used cameras to explore plants and animals in nature. Data from pre-program and after-program interviews, along with daily interviews, were analyzed using critical incident technique to distinguish the most important aspects of the students outdoor education experience. Shanely found that the sixth grade students in the outdoor education program perceived their outdoor experience as positive and agreed to implement a plan to care for the outdoors when they returned home. Cameras and daily journals provided them with the ability to reflect on what they saw along with the ability to write about and discuss their reactions.

Successful environmental programs encourage interaction with the environment and promote stewardship among students (Conde & Sanchez, 2010; Riordan & Klein, 2010; Shanely, 2006). For this study, students broke down the standards, identified vocabulary words for the topics, and researched the topics of pollution, conservation, and recycling. Next, students used netbooks to understand the meaning of the words and to find facts about environmental issues.

Attitudes and Science

Fishbein and Ajzen (1975) defined attitudes as "affective or evaluative in nature, and that it is determined by the person's beliefs about the attitudes object. Most people hold both positive and negative beliefs about an object, and attitudes is viewed as corresponding to the total affect associated with their beliefs" (p. 14). Pajares (1992) defined beliefs as "individual's judgment of the truth" (p. 316). Attitudes and beliefs about science manifest in acts or actions of the teacher in the classroom (NRC, 2000).

Beliefs about science influence a person's behavior, which causes a person to act a certain way (Fishbein & Ajzen, 1975). Attitudes either positively or negatively influence how motivated students are to learn about different scientific concepts (Chiappetta & Koballa, 2002).

Gardner (1975) defined two specific phrases: *attitudes to science* and *scientific attitudes*. *Attitudes to science* refers to views children develop when interacting with different scientific experiences. *Scientific attitudes* are the skills and/ or procedures necessary to think through the scientific process of inquiry. This study was designed to examine *attitudes* about environmental education. Understanding attitudes towards science provides researchers or teachers with the ability to delve into the psychological understanding of the individual's beliefs about science. Simpson, Koballa, Oliver, and Crawley (1994) stated:

> The science education literature contains hundreds if not thousands of reports of interventions designed to change attitudes. Development of programs to influence the likelihood of certain science-related attitudes is important because it is assumed that changes in attitude will result in changes in behavior. (p. 223)

Student attitudes towards science have been extensively researched over the past 40 years. Teachers' attitudes and methods for teaching science affect their students' performance and attitudes (Ormerod & Duckworth, 1975; Osborne, Simon, & Collins, 2003).

Elementary school students' enthusiasm toward science is high but starts to decline at the end of the elementary school (Osborne et al., 2003; Pell & Jarvis, 2001). However, these attitudes can be changed if a person's favorable or unfavorable beliefs towards science can be re-developed through curriculum planning or instructional practices (Fishbein & Ajzen, 1975; Koballa & Crawley, 1985; Koballa & Shrigley, 1983). When students are not allowed to actively experience science and understand the scientific concepts, their science attitudes' remain relatively unchanged or negative (Jones et al., 2000; Kahle et al., 1983). Students are more interested in science content areas that are interesting and relevant to their lives. Attitudes toward science, exhibited either by the teacher or the students, shape their understanding of the concepts presented during the unit or lesson (Osborne et al., 2000). Attitudes can be transformed through positive experiences and interactions. Osborne, Simon, and Tytler (2009) believed research demonstrates that positive science attitudes should be promoted at all levels to encourage future scientists.

Gardner (1975) reviewed two types of methods to measure science attitudes. The first type is Likert, in which participants score statements using a scaled set of criteria, from strongly agree to strongly disagree. The second method is interest inventories, which usually identify a career, topics, and activities of interests to an individual. These types of methods to measure attitudes are a guide for teachers to evaluate the success of a science curriculum or a strategy. Ramsden (1998) explained, "Any tool used to assess attitudes would therefore need to be developed within the context of what pupils might justifiably be expected to know about science as a result of the science experience in school" (p. 133). Osborne (2003) stated, "negative attitudes towards school science, useful insights could be obtained by focused studies of classrooms where effective teaching of science, as judged by students, was to be found…the teacher variables that are the most significant factor determining attitude, not curriculum variables" (p. 1070).

Surveys or inventories can be used to guide educators when they are making instructional improvements with regards to scientific inquiry and understanding along with attitudes towards science.

Attitudes toward Science Research

Knowledge and attitudes about environmental issues are directly linked to students' experiences. Students must have time to interact with the environment to improve their scientific understanding (Barwin, 2009; Chandler & Swartzentruber, 2011). Questionnaires are useful to identify student attitudes about environmental understanding and concerns in their community, while also providing teachers with the foundation and understanding to create and adjust environmental programs for their students (Naquin et al., 2010; Rocas et al., 2009).

Chandler and Swartzentruber (2011) conducted a quantitative study to determine if the understanding of nature concepts transferred into better science grades. Fifty-six fourth grade students in two schools participated in the study. Chandler and Swartzentruber administrated a pre-test and post-test Nature Awareness Survey to document changes in student's nature awareness scores. A Pearson correlation and a Spearman's rho were used to determine correlation between science Tennessee Comprehensive Assessment Program (TCAP) scores and the students' nature awareness scores. A significant relationship ($p < .01$) was found between the TCAP scores and the students' nature awareness scores. Chandler and Swartzentruber recommended that students need to spend time observing nature and/or in outdoors to improve their scientific understanding.

Naquin et al. (2010) conducted a mixed methods research study using an online survey with fourth through eighth grade students in a university laboratory school to examine the students' knowledge, attitudes, and practice about environmental issues. The survey was analyzed using chi-square statistics to determine difference in responses by gender and grade level on closed questions and coding was used to analyze the open-ended questions. Naquin et al. (2010) found that elementary school students and female junior high students were more likely to practice environmental activities to conserve resources. Male students were more aware of "global warming" than female students (p. 48) but the female students were more willing to support environmental projects to clean up the environment. Naquin et al. recommend environmental education at all grade levels so that students will have an opportunity to share their opinions about environmental issues and apply what they learn in class in their communities. Surveys are useful to identify students' attitudes toward environmental concerns such as pollution, conservation, and recycling in the local community and globally.

Barwin (2009) conducted a qualitative study to identify the effectiveness of a message in a video created by 17 middle school students to engage their peers in some type of environmental action. Questionnaires, videos, and written reflections were analyzed using Atlas. ti software. Barwin found that when students utilized video media to deliver a message about different environmental problems, their peers were more willing to change their attitudes about these environmental issues. Also, the students that were involved in the environmental video production become more concerned about the environment.

Rocas et al. (2009) conducted a mixed methods study using a researcher-made environmental survey and student made questionnaire with 64 secondary students taking an Environmental Control Technical course. The students participated in a variety of environmental activities, including making a video about environmental issues. Questionnaires were analyzed by gathering the answers to the open and closed questions, looking at the frequency of the answers, putting the frequent answers in categories, and then discussing their findings. Rocas et al. found that a student-made video about the environment changed the attitudes of the students regarding the environment as well as their peers. One of the most interesting survey data findings was that teachers need to constantly reinforce recycling and awareness strategies to maintain behavior change in the school.

Attitudes about the environment change and are more positive when students are actively engaged in activities. Questionnaires, surveys, and scales provide a guide to understand the individual's attitudes about the environment (Barwin, 2009; Chandler & Naquin et al., 2010; Rocas et al., 2009; Swartzentruber, 2011). For this study, the NEP-C revised examined an individual's change in environmental worldviews as a result of intervention of the inquiry based learning through use of public service announcements. Student interview questions provided an additional snapshot about how the students' attitudes were changed as a result of the pollution, conservation, and recycling public service announcements.

Technology and Science Research

Sandholtz, Ringstaff, and Dwyer (1997) said, "Technology provides an excellent platform-a conceptual environment-where children can collect information in multiple formats and then organize, visualize, link, and discover relationships among facts and events" (p. 176). Technology is a useful tool for students to explore their understanding of scientific concepts taught in the classrooms. It has been shown to be an effective instructional tool (Bosseler, 2005; Chang et al., 2011; Hickey et al., 2002). Technology should be used in conjunction with inquiry-based learning to improve scientific knowledge (Layman, 1996).

Chang et al. (2011) conducted a quantitative study to determine the impact of using WebQuest on students' perceptions of the environment. One hundred and three sixth-grade students were grouped into three groups (n=34 students in each): traditional instructional, traditional instruction with WebQuest, and WebQuest instruction with outdoors. The participating teachers made questionnaires and pre/post assessments were analyzed using three different statistic methods: (1) one-way ANCOVA to identify learning performance differences of the different groups; (2) k-method clusters to distinguish the performance between students' participation levels and their learning portfolios; and (3) regression analysis to find the connection between the student's performance and their satisfaction. Chang et al. found that WebQuest was an important technology device for students to acquire more understanding of scientific concepts through outdoor experience, as well as to develop critical thinking skills. Data from the questionnaire provided the researcher with evidence that the different instructional groups were concerned about environmental issues.

Bosseler (2005) conducted a qualitative study to determine if technology increased scientific knowledge of animals, ecology, and other environmental ideas. Three science club individuals participated in the study. Bosseler utilized social interactions, surveys, E-folios, interviews, and observations, along with photographs and field notes for the study. Data were analyzed by using the Qualitative Software Research Data Analysis or QSR, which is a program that organizes unstructured non-numerical data. Bosseler found that the students' learning benefitted greatly from use of technology in the science club. The internet and E-folios provided the students with tools and strategies to research information and gain a better understanding of animals, ecology, and other environmental ideas.

Hickey et al. (2002) conducted a mixed methods study using formative and summative rubrics to explore the collaboration among middles school students and the use of video technology in seven classrooms that taught genetics. Graduate students rated the middle school students' videos along with the students themselves. A collaborative formative assessment provided the respective groups with a framework to grade the video and guidance during the creation of the videos. Hickey et al. (2002) found that the students believed it enhanced their learning and improved their participation in class along with increasing their genetic knowledge and understanding.

Technology is an instructional tool for children to use in the classroom. Studies have been conducted using technology to understand science and other environmental concepts (Bosseler, 2005; Chang et al., 2011; Hickey et al., 2002). For this study, students used netbooks and an I-pad to research and create videos about pollution, conservation, and recycling.

Summary

This chapter reviewed the literature associated with inquiry-based learning, attitudes, environmental education, and ecopedagogy along with the research about inquiry-based learning, attitudes about environmental education, and technology. Inquiry-based learning has grown and developed out of John Dewey's philosophical belief that education begins with the learner's curiosity about their surroundings. In the 1960s, Joseph Schwab (1961) expanded the ideas of inquiry and Robert Karplus' (1964) learning cycle further defined the process of inquiry. Later, these inquiry based learning strategies were used to define scientific literacy and standardization. The National Research Council helped to change the inquiry process to focus on four strands of science learning practices.

Environmental education was established to increase societal consciousness of environmental problems so that the world population might be motivated find a solution. National and state standards were developed. National organizations, such as NAEE and EEA, provide teachers with professional learning opportunities and funding to improve environmental instruction. The theoretical framework of ecopedagogy challenges students to become aware, discuss, and think about current environmental issues. Research also suggests environmental education creates and fosters stewardship among participants when students are actively engaged Conde & Sanchez**,** 2010**;** Riordan & Klein, 2010; Shanely, 2006).

Attitudes towards science are either positively or negatively reinforced by the actions of the teacher in the classroom (Chiappetta & Koballa, 2002). Some types of questionnaires, surveys, and scales offer teachers a guide to understanding their students' attitudes about the environment (Barwin, 2009; Chandler & Swartzentruber, 2011; Naquin et al., 2010; Rocas et al., 2009).

Technology has become an integral part of everyday instruction for students to explore scientific concepts and develop an understanding of different topics taught in the classroom (Bosseler, 2005; Chang et al., 2011; Hickey et al., 2002). Furthermore, research showed that students' achievement and attitudes about the environment changed when they were actively engaged in inquiry-based learning through the use of technology.

CHAPTER 3

METHODOLOGY

"By predisposing men to reevaluate constantly, to analyze 'finding,' to adopt scientific methods and processes, and to perceive themselves in dialectical relationship with their social reality, that education could help men to assume an increasingly critical attitude toward the world and so to transform it"

-Freire, 1973, p. 34.

This chapter describes the mixed methods used to investigate the research questions for the pollution, recycling, and conservation third grade science unit. The chapter begins with the purpose statement and research question, followed by the setting and participants for the study. Research design, instruments used in the study, procedures, and timeline of the activities explanations follow. Finally, data analyses conducted are discussed.

Purpose Statement and Research Questions

The purpose of this study was to investigate how integrating an inquiry-based learning and a technology component of a public service announcement into a pollution, recycling, and conservation unit impacted students' environmental achievement and attitudes. The overarching research question for this mixed method research inquiry-based study was:

> What was the impact on third grade students' achievement and attitudes when integrating inquiry-based learning with a technology-based public service announcement component in a pollution, conservation, and recycling unit? This question was broken into two parts:

1. Are there differences between third grade students' achievement scores as a result of using inquiry-based learning when teaching the pollution,

conservation, and recycling unit?

2. Do third grade students' attitudes about pollution, conservation, and recycling change as a result of using inquiry-based learning?

Setting

The school used for this study was a pre-kindergarten through fifth grade elementary school located in Northeast Georgia. Historically, this community and school are very mindful of environmental concerns and encourage recycling and conservation programs in all public schools. The elementary school is a Title I school with enrollment of approximately 552 students. Sixty-eight percent of the students at this elementary school receive free lunches and 14% of the students receive reduced-fee lunch. The ethnic breakdown was approximately 10% Hispanic/Latino, 5% Asian, 45% African American, 4% Two/More Races, and 36% Caucasian. Sixty-one percent of the students were male and thirty-nine percent were female. The exceptionality breakdown of the school was approximately 11% Gifted Education, 17% Special Education, and 5% English to Speakers of Other Language (ESOL) (Infinite Campus, 2012).

The third grade at this school consisted of four classrooms with total of approximately 88 students. One of the classrooms was a collaborative classroom where the special education teacher team taught with the regular education teacher in the same room. All of the classrooms are taught using a self-contained model for science. The exceptionality breakdown of the third grade was approximately 21% Gifted Education, 17% Special Education, and 11% English to Speakers of Other Language (ESOL). The ethnic breakdown for the third grade was 8% Hispanic/Latino, 8% Asian, 43% African American, 7% Two/More Races, and 34% White. Sixty percent of the third graders were male students and forty percent were females (Infinite Campus, 2012). Table 3 represents the ethnic breakdown of the elementary school and the third grade population of this school. Table 4 represents the Exceptionality Breakdown of the School and Third Grade.

Table 3

Ethnic Breakdown of the School and Third Grade

	Elementary School (N=552)	Third grade (N=88)
Hispanic/Latino	54	7
Asian	28	7
African American	251	38
Two/More Races	22	6
Caucasian	197	30

Table 4

Exceptionality Breakdown of the School and Third Grade

	Elementary School (N=552)	Third grade (N=88)
Gifted Education	64	18
Special Education	95	15
English to Speakers of Other Language (ESOL)	25	10
General Education	368	45

Participants

Two non-collaborative third grade classrooms were used in this study. The researcher taught the unit to both classrooms. The researcher's classroom was the experimental classroom. The experimental classroom consisted of twenty-one third grade students who ranged in age from eight to ten years old. There were nine girls and twelve boys in the class. Out of the twenty-one students, five were in the gifted program and five were in the Early Intervention Program or EIP for math and/or reading instruction. Five students were in the English to Speakers of Other Language (ESOL) program. One fourth of the students (n= 5) received free or reduced lunches. The control classroom consisted of twenty-one third grade students who ranged in age from eight to ten years old. There were eight girls and thirteen boys in the class. Out of the twenty-one students, two were in the gifted program, three were in the Early Intervention Program or EIP for math and/or reading instruction, and five were in the English to Speakers of Other Language (ESOL). One fourth of the students (n=5) received free or reduced lunches (Infinite Campus, 2012). Table 5 represents the demographics for the experimental and control groups for this study.

Table 5

Demographics for the Experimental and Control Groups

	Experimental (N=21)	Control (N=21)
Gifted	5	2
Early Intervention Program	5	3
English to Speakers of Other Language (ESOL)	5	5
General Education	6	11

Research Design

This study used a methodological theoretical framework of mixed methods with the guidance of action research. The mixed methods design provided an opportunity to combine quantitative and qualitative research methodologies to evaluate the data for this type of study (Creswell & Clark, 2011). Quantitative analyses were conducted as a two group, pre-test-post test design to compare the achievement using the third grade Harcourt School Publishers Science Pollution and Conservation Unit Test and attitudes using the New Ecological Paradigm Scale for Children (revised). Qualitative analyses were conducted using student interview questions that were transcribed, coded, and analyzed for comment themes. Action research provided a framework to search for ways to improve classroom strategies by critically reflecting on educational practices (Elliot, 2007).

Johnson, Onwuegbuzie, and Turner (2007) defined mixed methods research as, "the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes" (p. 124). Tashakkori and Creswell (2007) additionally noted it is where the "researcher the investigator collects and analyzes data, integrates the findings, and draw inferences using both qualitative and quantitative approaches or methods in a single study or program of inquiry" (p. 4).

The use of mixed methods research has advantages. Advantages are mixed methods are stronger when researchers use narratives, words, and pictures of qualitative research to find meaning in the numbers of the quantitative research. Mixed methods answer a wider range of research questions because the research is not restricted to either qualitative or quantitative. The conclusion of the study is stronger when evidence is collaborated with the data from both qualitative and quantitative methods (Johnson & Onwuegbuzie, 2004).

For the research questions in this study to be answered, both methods were applied. Quantitative methods were used to assess the achievement of the students (Pollution and Conservation pre/post unit tests) and attitude changes (New Environmental Paradigm Scale for Children). Qualitative methods, through interview questions, were used to assess how the unit impacted students' attitudes about pollution, recycling, and conservation. For research question one, the dependent variable was the Pollution and Conservation unit test score and the independent variable was the inquiry-based learning instructional strategy of the four strands of science practices using a technology-based public service announcement component. For research question two, the dependent variables were the New Ecological Paradigm Scale for Children and interview questions. The independent variable was the inquiry-based learning instructional strategies of the four strands of science practices using a technology-based public service announcement component.

Action research is based on the assertion that all human beings are complex and searching for understanding about their lives and the world around them (Greenwood & Levin, 2007). This understanding is manifested in their actions and the way they reflect on them. Philosophically, action research involves ontology, epistemology, and methodology because it actively challenges individuals to better themselves and society through knowledge. Action research articulates ontological theories, given that individuals are able to use language to discuss their values and make societal changes through action. With regard to epistemology, action research gives people a method to experience knowledge through reflecting and critically examining this new understanding. With regards to methodology, actions research provides practitioners with a continuous process to plan, act, observe, and reflect to make sense of what they are learning (Greenwood & Levin, 2007).

There are advantages when using action research since it is a practical approach to improve practices in the classroom along with generating new theory. It is used by teachers who are critically examining themselves on a daily basis to find solutions to problems. They ask questions about what they are doing and how they can improve practices in their classrooms (Greenwood & Levin, 2007).

One of the founders of action research, John Elliott (1991), stated, “Action research integrates teaching and teacher development curriculum development and evaluation, research and philosophical reflection, into a unified concept of a reflective educational practice” (p. 54). Action research was chosen because it provided the researcher with a practical guide to change how students learn in the classroom along with a way to be less intrusive with students and their days. The action research process has a self-reflecting cycle of planning, acting, reflecting, and re-planning to initiate the dialectical change (Carr & Kemmis, 1986). The National Research Council’s four strands of science practices for learning science follow the same process but action research includes dialogue to guide reflection in the learning communities.

Action research provided a framework to interact, discuss, and reflect upon what the students learned during the daily closing activities for the lesson. Mixed methods research allowed the researcher to use both the quantitative and qualitative data to answer the research questions.

Instruments

Four instruments were used in this study:

1. Unit test from the Georgia Third grade Harcourt School Publishers Science’s Pollution and Conservation Unit (Appendix I)
2. New Ecological Paradigm Scale for Children (Appendix J)
3. Environmental Action Rubric (Appendix K)
4. Student Interview Questions

Descriptions of the instruments are listed below.

Third Grade Harcourt School Publishers Science Pollution and Conservation Unit Test

The third grade Harcourt School Publishers (2009) Science Pollution and Conservation Unit Test consists of twenty questions. Questions 1-8 are matching unit vocabulary words with their definition. Questions 9-16 are eight multiple choice questions that assess the concepts of pollution, conservation and recycling through real world applications scenarios. Questions 17-20 are open-ended questions where students write short essay answers about pollution, recycling, and conservation. The scores of the test ranges from 0 to 100. Each question is worth five points. Questions 1-16 are scored as either incorrect (0 points) or correct (5 points). Questions 17-20 are scored using from 0 to 5 point scale according to their answers (0 = no attempt to answer, 1 = one fact, 2 = two facts, 3 = some of the answer, 4 = most of answer, 5 = all the answer). For the Pollution and Conservation Unit Test, a higher test score corresponded to higher students' understanding of environmental concepts for the unit. Total scores and subscale scores (pollution, conservation, and recycling) were used for data analysis. Pollution subscale scores corresponded to those items mapped to standard S3L2a. Conservation subscale scores corresponded to those items mapped to standard S3L2b. Recycling subscale scores corresponded to those items mapped to standard S3L2b. Table 6 shows how the questions mapped to the unit standards (S3L2) and test subscale.

Table 6

Mapping of Science Georgia Performance Standards to Pollution and Conservation Unit Questions

	Matching	Multiple Choice	Essay
S3L2a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. (pollution)	1	9, 10, 12, 15	19
S3L2 b. Identify ways to protect the environment. • Conservation of resources (conservation)	2, 3, 4, 5, 6,	11, 13, 14,	17, 18 20
S3L2 b. Identify ways to protect the environment. • Recycling of materials (recycling)	7,8	16	

The test on pollution, conservation, and recycling is required by the county. The school grade level team agreed that the Georgia Third Grade Harcourt School Publishers Science Pollution and Conservation Unit Test measured and provided an accurate picture of a student understanding of the environmental standards (content validity). The publisher provided no reliability data for the test.

New Ecological Paradigm Scale for Children (revised)

The New Ecological Paradigm Scale was developed by Riley E. Dunlap and Kent D. Van Liere in 1978 after the emergence of environmental concerns in the 1970s. The authors created the survey to understand individual's environmental worldviews. The focus of the NEP was to recognize the beliefs of others to upset the balance of nature, the growth of society, and the right of man to rule over the rest of nature. The surveys were mailed out to 1,155 resident of the state of Washington and 676 were completed. The authors wanted balance of the five facets within the 15 items of (1) reality of limits of growth, (2) antianthropocentrism, (3) fragility of nature's balance, (4) reject of exemptionalism, and (5) possibility of ecocrisis. Over the years, the NEP has been tested in many different countries such as Japan, United States, Turkey, Sweden, and Baltic States as well as with different populations such as college students, environmentalists, farmers, and the general population (Dunlap, VanLiere, Mertig, & Jones, 2000). NEP-C was modeled after the adult version of New Ecological Paradigm Scale.

The New Ecological Paradigm Scale for Children (2007) was revised by Constantinos C. Manoli, Bruce Johnson, and Riley E. Dunlap after interviewing fifth grade students. The sample for the new survey consisted of fourth, fifth, and sixth grade students from 23 schools in Pennsylvania and Louisiana and focused on vocabulary on the survey to make it more child-friendly. The authors revised the NEP-C for children by changing the wording and reducing the number of items on the survey from 15 to 10 (Manoli, Johnson, & Dunlap, 2007) based on interviews. The NEP-C revised is divided into three subscales: Rights of Nature, Eco-crisis, and Human Exemptionalism. Rights of Nature measures how individuals value nature which reflects the standard for pollution. Eco-crisis assesses if individuals believe that there is a crisis in the environment which reflects the standards of conservation and recycling. Human Exemptionalism measures if individuals have respect towards animals and plants which address the standard of pollution (Manoli et al., 2007).

NEP-C Revised consists of 10 Likert scale items. Each item is rated as either strongly disagree, disagree, not sure, agree or strongly agree. The researcher scored each question using the following system: (1) strongly disagree, (2) disagree, (3) not sure, (4) agree, to (5) strongly agree. Items from each subscale were added together to obtain the total score. The scores ranged from 0 -50 points. A higher score on the NEP-C revised corresponded to a more favorable attitude for the students about environmental issues. Total scores were used for data analysis (Manoli et al., 2007).

In spring 2012, the researcher randomly selected six third grade students from the experimental group to examine the language of the New Ecological Paradigm Scale for Children revised for this study. The surveys were completed and turned in to the teacher. Then, the students were asked if they understood the questions on the survey. The teacher and students discussed each question to see if the survey was age appropriate for third grade students and also discussed whether or not the survey addressed pollution, recycling, and conservation issues. The final consensus among the group members was the survey was suitable for third graders and it did assess their individual attitudes towards pollution, recycling, and conservation. The paired sample t-test obtained a .83 reliability for the adult version along with predictive validity and content validity were established (Assessment Tools in Informal Science, n.d.). The author did not provide reliability data for the New Ecological Paradigm Scale for Children (NEP-C).

Environmental Action Rubric

The original Environmental Action Rubric had three categories and three ranges of scoring. The three environmental categories for the public service announcement were:

the content (of the standards), organization (easy to understand), and presentation of the video (interest and information in the video). The three ranges for the grades were: exceeds the standards (3 pts), meets the standards (2 pts), and progressing toward the standards (1 pts). The purpose of the Environmental Action Rubric was to evaluate the quality of public service announcements developed during the pollution, conservation, and recycling unit. The rubric was created by taking the standards and breaking down the vocabulary within each. The scores on the rubric ranged from 1 to 9. Each category was worth 3 points and was scored according to information in the public service announcement. A higher the score on the Environmental Action Rubric corresponded to a more favorable understanding of the environmental concepts. For this study, students were required to exceed the standards with a total score of 9 on the Environmental Action Rubric-Revised. This requirement demanded that the students include all the content of the standards (vocabulary words) for each topic, that the content was well organized and easy to follow, and that the presentation was well rehearsed with a delivery that would hold the attention of the audience. See Appendix K for further explanation of rubric score expectations.

In spring 2012, with parental approval, the researcher randomly selected six third grade students from her classroom to look at and provide suggestions about the rubric. These students, like their fellow classmates, had all participated in creating rubrics to evaluate their writing skills. After looking at the Environmental Action Rubric, the group recommended several revisions. The categories for assessment should only include progressing toward the standards, meets standards, and exceeds standards since these were the areas they were familiar with on other rubrics. The word ‘some’ for progressing and the word ‘most’ for meets would help them to understand the different categories of the Environmental Action Rubric, especially since it was the same language they understood from the writing rubric. Three science teachers volunteered to look at the rubric and made some additional recommendations. The teachers suggested adding the vocabulary words for each topic to be used in the presentation to the rubric. Finally, the teachers decided that the rubric addressed the language and content of the standards. All suggestions listed above by the students and teachers were included in the Environmental Action Rubric-Revised (EAR-R) (Appendix K). Total scores were used for data analysis.

The rubric was created to be used for this study to evaluate student understanding of environmental concepts of the pollution, recycling, and conservation. The EAR-R includes a number scoring system to increase validity of the rubric. Moskal and Leydens (2000) stated validity for a rubric increases when a number scoring system is part of the rubric, along with clearly stating the purpose of the evaluation. With regard to reliability, EAR-R rubric provides a set of criterion for users so they can refer to it.

Student Interview Questions

Five, randomly-selected students from the experimental group were asked questions from categories A and B to guide their discussion and five randomly selected students from the control group were asked questions from categories A and C to guide their discussion. These interview questions were used at the end of the unit to determine the students’ attitudes about the environmental unit. The students were asked the following overarching questions along with the follow-up questions:

A. What did you learn about pollution, recycling, and conservation from the unit? (experimental group and control group)

   1. Do you believe that there is a pollution problem in our community? Why or why not?
   2. Have you changed your mind about pollution? Why or why not?
   3. How could you to get other people, like your family or friends, to recycle?
   4. How could you get other people, like your family or friends, to conserve resources?

B. What did you think about the use of inquiry-based learning strategies and technology in the pollution, recycling, and conservation unit? (experimental group)

   1. Do you believe the technology was useful in this project? Why or why not?
   2. What are some of your feelings about using the netbooks and I-pods to make the public service announcement?
   3. What did you like the most about the pollution, recycling, and conservation unit? Why?
   4. What did you like the least about the pollution, recycling, and conservation unit? Why?

C. Do you think the use of technology in the pollution, recycling, and conservation unit would help you understand the material? (control group)

   1. What are your feelings about using technology in the classroom?
   2. Do you think using technology would help you understand the pollution,

recycling, and conservation unit better?

3. What type of technology could we use to make this unit on pollution, recycling, and conservation better?

The student interview questions were piloted for this study. The researcher, in spring 2012 with parental approval, randomly selected two groups of five third grade students from two third grade classrooms. Each group was given the interview questions after the pollution, recycling, and conservation unit was taught and asked if the questions made sense to them. The teacher read out the questions and the students discussed if the questions were age appropriate for third grade students. The students then made recommendation on how to improve the language of each question so future third grade could understand the meaning. Their suggestions were: (1) Do you think the use of technology will help you understand the pollution, recycling, and conservation unit? Instead of do you think the use of technology in the pollution, recycling, and conservation unit would help you understand the material?; (2) What are your feelings about using technology in the classroom? Instead of what are your feelings about technology usage in the classroom?; (3) Do you think using technology would help you understand the pollution, recycling, and conservation unit better? Instead of do you think the use of technology for the pollution, recycling, and conservation unit would help you understand the material? Table 7 represents the modification to the interview questions. Table 8 is a mapping of the research questions to the literature.

Table 7

Modifications of Student Interview Questions

Original Question	Modified Question
Do you think the use of technology in the pollution, recycling, and conservation unit would help you understand the material?	Do you think the use of technology will help you understand the pollution, recycling, and conservation unit?
What are your feelings about technology usage in the classroom?	What are your feelings about using technology in the classroom?
Do you think the use of technology for the pollution, recycling, and conservation unit would help you understand the material?	Do you think using technology would help you understand the pollution, recycling, and conservation unit better?

Table 8

Interview Questions and Research Studies that Support each Question

Category	Question	Research Study
A. (experimental group and control group)	What did you learn about pollution, recycling, and conservation from the unit?	Conde & Sanchez, 2010; Naquin et al., 2010; Riordan & Klein, 2010.
B. (experimental group)	What did you think about the use of technology in the pollution, recycling, and conservation unit?	Barwin, 2009; Harris, 2009; Hendrix et al., 2012; Minoque et al., 2010; Shanely, 2006; Tuan et al., 2005.
C. (control group)	Do you think the use of technology in the pollution, recycling, and conservation unit would help you understand the material?	Barwin, 2009; Bosseler, 2005; Rocas, et al., 2009; Shanely, 2006.

Procedures

Before the Pollution and Conservation unit was taught, students from the experimental and control groups took the Georgia Third grade Harcourt School Publishers Science Pollution and Conservation Unit Test (2009) (see Appendix I). Students from the control and experimental groups completed the New Ecological Paradigm Scale for Children revised (see Appendix J). All students that had problems reading the test and survey were read aloud to as part of their 504 accommodations. The control and experimental groups received instruction on the same topics of the effects of pollution on animal and plants; recycling of materials; and conservation of resources over a three week period 50 minute instructional period. For the control group, the researcher used the same environmental standards at the same time as the other third grade classes during the science period of the day. For the experimental group, the researcher used the same environmental standards during the reading and language art period. The students received reading and language art standards during the science period during the school day. Narratives and instructional lesson plan timelines for both groups are noted in Appendix M and Appendix N.

For this study, students in the control group used the pre-planned curriculum learning process, which included the third grade science textbook, experiments or labs, and science workbook. Students broke down the standards for the unit before reading the chapter to identify key vocabulary words. Student read the chapter with a partner and wrote down five important facts. The student wrote the experiment prediction and conclusions in the science journals. Students completed science workbook pages. To review the units of pollution, conservation, and recycling, students completed the end of the chapter review and played environmental jeopardy.

For this study, students in the experimental groups used the four strands for students to learning science practices as a learning cycling which include: (1) understanding scientific explanations;(2) generating scientific evidence; (3) reflecting on scientific knowledge; and (4) participating productively in science (NRC, 2007). The students broke down the standards to understand the scientific explanations and vocabulary words for pollution, conservation, and pollution. Next, the students used their netbooks to research the different topics for generating scientific knowledge. Then the student wrote scripts, planned their settings, and reflected upon their environmental solutions. Finally, the students created a public service announcement to participate productively in science.

After the completion of the public service announcements and the unit, students in the experimental and control groups completed the following instruments. First, the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit Test was administrated and scored. Next, students completed the New Ecological Paradigm Scale for Children and it was scored by the researcher. For the experimental group, three third grade science teachers scored the finished products or videos using the Environmental Action Rubric-Revised (see Appendix K). Interrater reliability was calculated to see if the students met the standards. The teachers reviewed the Environmental Action Rubric and discussed the three environmental categories for the public service announcement which were content (of the standards), organization (easy to understand), and presentation of the video (interest and information in the video). Then the teachers reviewed the three grades of Exceeds the standards (3 pts), Meets the standards (2 pts), and Progressing toward the standards (1 pts). The categories were worth 3 points each, with a total possible score of 9. The teachers watched the videos and rated them. Next, the teachers watched the videos again and discussed their scores. This process was continued until all videos had been viewed and scored.

The experimental and control groups participated in an audio taped interview. Five randomly selected student groups from each class were chosen (experimental n=21 and control n=19). Each student was seated around a table facing the researcher with a list of interview questions and a tape recorder. After the students were seated, the researcher began by reviewing the procedures for the interviews. The students agreed to go around the table and have each student answer questions in order using the Morning Meeting or focus group format. Students gave permission to start the interview. During the interviews, students were relaxed and answered the interview questions without any distractions. Each interview lasted 10 minutes. After the interview questions were answered, the research thanked the students for participating and returned to class. Interviews were transcribed at the conclusion of the interviews. Audio tapes were transcribed, coded, and analyzed. Survey data was analyzed by using the transcripts to identify important statements or phrases. The statements and phrases were then refined into themes about pollution, conservation, recycling and technology. Data was analyzed to answer the research questions.

Data Analysis

Analyses were conducted to answer the overarching research question. For research question one, three analyses were conducted. First, an analysis of covariance

(ANCOVA) was conducted to determine if there were differences in unit scores. Second, effect size was calculated to determine if there were differences in achievement gains by class. Third, the Environmental Action Rubric-Revised was scored to determine the mastery of concepts from the environmental unit. For research question two, two analyses was conducted. First, An Analysis of Variance (ANCOVA) survey of total scores were used to determine attitudes changes from the pre/post test New Ecological Paradigm Scale for children (NEP-C). Second, audiotape interview questions were listened to multiple times for accuracy and then transcribed. The text was coded to identify the themes about students' attitudes. Charts were created to organize students' comments about pollution, conversation, and recycling along with the use of technology.

Summary

The purpose of this study was to investigate how integrating inquiry-based learning with a technology component of a public service announcement into a pollution, recycling, and conservation unit impacted students' environmental achievement and attitudes. Using mixed methods and action research, the research collected data over a 14 day 50 minute instructional period from students in two third grade science classrooms. Quantitative data was obtained from the pre-test and post tests from the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit and with scored rubrics from the Environmental Action Rubric-Revised (EAR-R). The EAR-R provided further evidence to the students' understanding of the Pollution and Conservation Unit. The qualitative data collection was in the form of the pre-test and post test from the New Ecological Paradigm Scale for Children along with dominant themes from the interviews identified students' attitudes about the unit. Prior to conducting the full-scale study, the researcher field-tested the New Ecological Paradigm Scale Survey for Children, Environmental Action Performance Task and Rubric, and Interview Questions to determine if the language of the different instruments was age-appropriate for third grade students and all instruments were suitable for the study. The research questions and the data that addresses the questions are presented in Chapter 4.

CHAPTER 4

DATA ANALYSIS AND FINDINGS

"A person who has gained the power of reflective attention, the power to hold the problems, questions, before the mind, is in so far, intellectually speaking educated. He has the mental discipline-power of the mind and for the mind"

-Dewey, 2001, p. 93.

The purpose of the study was to investigate how integrating an inquiry-based learning and a technology component of a public service announcement into a pollution, recycling, and conservation unit impacts students' environmental achievement and attitudes. This chapter presents the findings of this study associated with the research questions for the pollution, conservation, and recycling unit. The chapter begins with the research questions, description of participants, findings, research question two, and summary.

Research Questions

The overarching research question for this mixed methods research inquiry-based study was:

What was the impact on third grade students' achievement and attitudes when integrating an inquiry-based learning and technology-based public service announcement component in pollution, conservation, and recycling unit?" This question was broken into two parts:

1. Are there differences between third grade students' achievement scores as a result of using inquiry-based learning when teaching the pollution, conservation, and recycling unit?
2. Do third grade students' attitudes about pollution, conservation, and recycling changed as a result of using inquiry-based learning?

Participants

The participants for this study were two third grade classrooms. The experimental classroom consisted of 21 third grade students who ranged in age from eight to ten years old. There were nine girls and twelve boys in the class. The ethnic breakdown for the experimental group was four Hispanic/Latino, two Asian, five African American, one Two/More Races, and nine Caucasian. Out of the 21 students, five were in the gifted program while five were in the Early Intervention Program or EIP for math and/or reading instruction. Five students were in the English to Speakers of Other Language (ESOL) program. No students left the experimental group during the study. The control classroom consisted of 19 third grade students who ranged in age from eight to ten years old. There were six girls and thirteen boys in the class. The ethnic breakdown for the control group was one Hispanic/Latino, three Asian, nine African American, one Two/More Races, and five Caucasian. Out of the 19 students, two were in the gifted program, three were in the Early Intervention Program or EIP for math and/or reading instruction, and five were in the English to Speakers of Other Language (ESOL) (Infinite Campus, 2012). At the beginning of the study, the control group had twenty-one students; however, two students left during the first two days of the study. Table 9 represents the exceptionality breakdown for the experimental and control groups. Table 10 represents the ethnic breakdown for the experimental and control groups.

Table 9

Exceptionality Breakdown for the Experimental and Control Groups

	Experimental (N=21)	Control (N=19)
Gifted	5	2
Early Intervention Program	5	3
English to Speakers of Other Language (ESOL)	5	5
General Education	6	9

Table 10

Ethnic Breakdown for the Experimental and Control Groups

	Experimental Group (N=21)	Control Group (N=19)
Hispanic/Latino	4	1
Asian	2	3
African American	5	9
Two/More Races	1	1
Caucasian	9	5

Research Question One

Are there differences between third grade students' achievement scores as a result of using inquiry based learning when teaching the pollution, conservation, and recycling unit?

To answer question one, the researcher calculated the Pollution and Conservation Unit Test scores from pre/post tests. The total score on the Pollution and Conservation Unit Test was computed by adding the three content sections of pollution, conservation, and recycling. An analysis of covariance was used to assess the Pollution and Conservation Unit Test scores from both the control and experimental groups using the SPSS statistical software. The pre-test and post test scores were entered into the spreadsheet. The value of co-variance was checked along with the homogeneity of regression slopes. An analysis of covariance (ANCOVA) was conducted to determine if there were differences in total scores. The researcher entered the mean score and the standard deviation score from the experimental and control groups in the effect size calculator to determine the effect size. The charts were created by the research using the Excel spreadsheet for pre-test and post test to provide a picture of how students performed on their Pollution and Conservation Unit test along with the content areas. The Environment Action Rubric-Revised scores were analyzed to assess students' understanding of the Pollution and Conservation Unit.

Georgia Third Grade Harcourt School Publishers Science's Pollution and Conservation Unit Test

A total of 40 students completed the Georgia Third grade Harcourt School

Publishers Science's Pollution and Conservation Unit Test with a scoring range of 0-100. For the control group, the mean pre-test score was 27.32 with a standard deviation of 19.03, which are reported in Table 10. For the experimental group, the mean score for pre-test was 29.71 with a standard deviation of 14.79, which are reported in Table 11. For the control group, the mean post test score was 64.26 with a standard deviation of 21.90, which are reported in Table 11. For the experimental group, the mean score for post-test was 85.19 with a standard deviation of 16.41, which are reported in Table 12.

Table 11

Pre-test Scores on the Pollution and Conservation Unit Test

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	control	19	27.3158	19.02645	.36497
	Experimental	21	29.7143	14.78561	3.22648
	Total	40	28.5750	16.71582	2.64887

Table 12

Post-test Scores on the Pollution and Conservation Unit Test

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest	control	19	64.2632	21.90343	5.02499
	Experimental	21	85.1905	16.41225	3.56832
	Total	40	75.2500	21.71582	3.43175

Both groups began the unit with the basically the same level of knowledge about pollution, conservation, and recycling. However, the experimental group scored significantly higher on the post test then the control group. Figure 1 shows changes in the pre-test and post test scores for each student in the control group. Figure 2 shows changes in the pre-test and post test scores for each student in the experimental group.

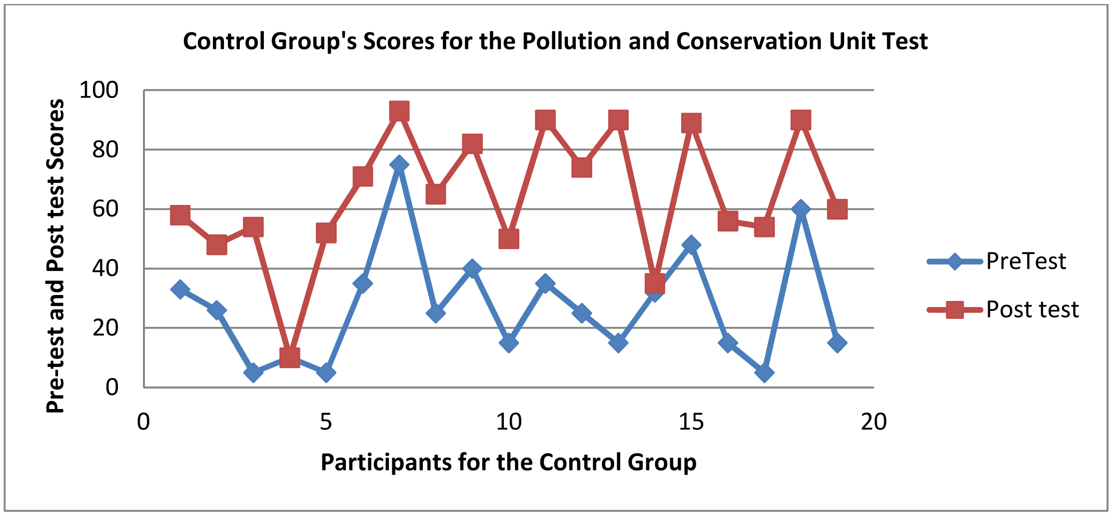

Figure 1. Control Group's Pre-Post Test Scores from the Pollution and Conservation Test.

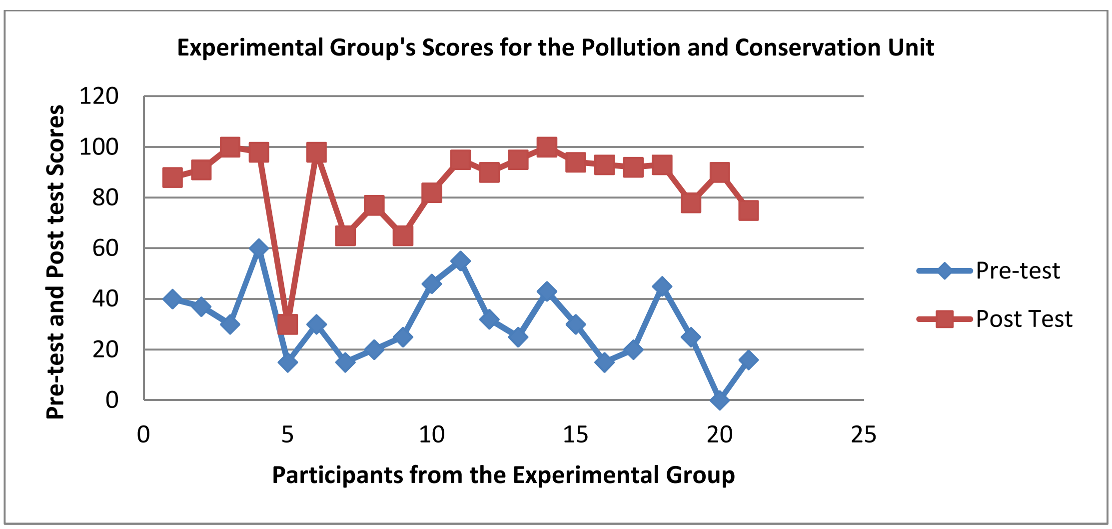

Figure 2. Experimental Group's Pre-Post Test Scores from the Pollution and Conservation Test.

An analysis of covariance (ANCOVA) was conducted to determine if there were differences in total scores. The homogeneity-of-regression (slopes) assumption, which indicates the relationship between the covariate (pre-test) and the dependent (post test), did not differ significantly as a function of the independent variable, $F(1, 38) = (.612, p = .439)$ therefore, an ANCOVA test was appropriate to conduct on the data. The ANCOVA test was significant, $F(1, 38) = 14.26$, $p < .001$. This analysis determined that students in the experimental group ($M = 85.19$) had significantly higher total scores on the Pollution and Conservation Test than the control group ($M = 64.26$), controlling for pretest scores. The effects sizes for the groups were significant using the Cohen's d the score obtained was 1.310.

Content Area Score for Pollution, Conservation, and Recycling

Specific content area scores of pollution, conservation, and recycling on the Pollution and Conservation test also were analyzed. The total of content area section of the Pollution and Conservation test are pollution (0-30 pts), conservation (0-55pts), and recycling (0-15pts.). For the pre-test, the control group scored a mean of 7.89 on pollution, mean of 14.95 on conservation, and a mean of 4.47 on recycling. The experimental group scored a mean of 11.33 on pollution, a mean of 13.86 on conservation, and a mean of 4.52 on recycling. For the post-test, the control group scored a mean of 19.58 on pollution, mean of 34.68 on conservation, and a mean of 10.00 on recycling. The experimental group scored a mean of 26.19 on pollution, a mean of 46.14 on conservation, and a mean of 12.86 on recycling. Both groups improved their scores significantly on all sections from the pre-test to the post-test. Both groups began the unit with the basically the level of knowledge about pollution, conservation, and recycling.

However, the experimental group scores on each section were better than the control group. Table 13 represents the pre-test mean, standard deviation, and standard error mean for the control and experimental groups on the Pollution and Conservation Test. Table 14 represents the post-test mean, standard deviation, and standard error mean for the control and experimental groups on the Pollution and Conservation Test.

Table 13

Section Analysis on Pollution and Conservation Unit Test (Pre-Test)

	Group	N	Mean	Std. Deviation	Std. Error Mean
pollution	control	19	7.8947	6.55655	1.50417
	experimental	21	11.3333	7.75457	1.69219
conservation	control	19	14.9474	10.67954	2.45006
	experimental	21	13.8571	7.65693	1.67088
recycling	control	19	4.4737	4.04651	.92833
	experimental	21	4.5238	3.12440	.68180

Table 14

Section Analysis on Pollution and Conservation Unit Test (Post-Test)

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pollute	control	19	19.5789	7.12831	1.63535
	experimental	21	26.1905	3.44411	.75157
Conserve	control	19	34.6842	13.19955	3.02818
	experimental	21	46.1429	12.53908	2.73625
Recycle	control	19	10.0000	5.27046	1.20913
	experimental	21	12.8571	3.38062	.73771

Pollution

An analysis of covariance (ANCOVA) was conducted on the 30 point pollution section of the Georgia Third grade Harcourt School Science test scores. The first analysis of the data was the homogeneity-of-regression (slopes) assumption, which indicates the relationship between the covariate (pre-test) and the dependent (post-test) did not differ significantly as a function of the independent variable, $F(1, 38) = 2.59$, $p = .12$. The ANCOVA test was significant, $F(1, 38) = 11.28$, $p < .002$. The results showed that students in the experimental group ($M = 26.19$) had significantly higher scores on the Pollution and Conservation Test than control group ($M = 19.58$), controlling for pretest scores. The effects sizes for the groups were small using the Cohen's d the score obtained was 0.48. Figure 3 shows changes in the pre-test and post test scores on pollution section of the Pollution and Conservation test for each student in the control group. Figure 4 shows changes in the pre-test and post test scores on pollution section of the Pollution and Conservation test for each student in the experimental group.

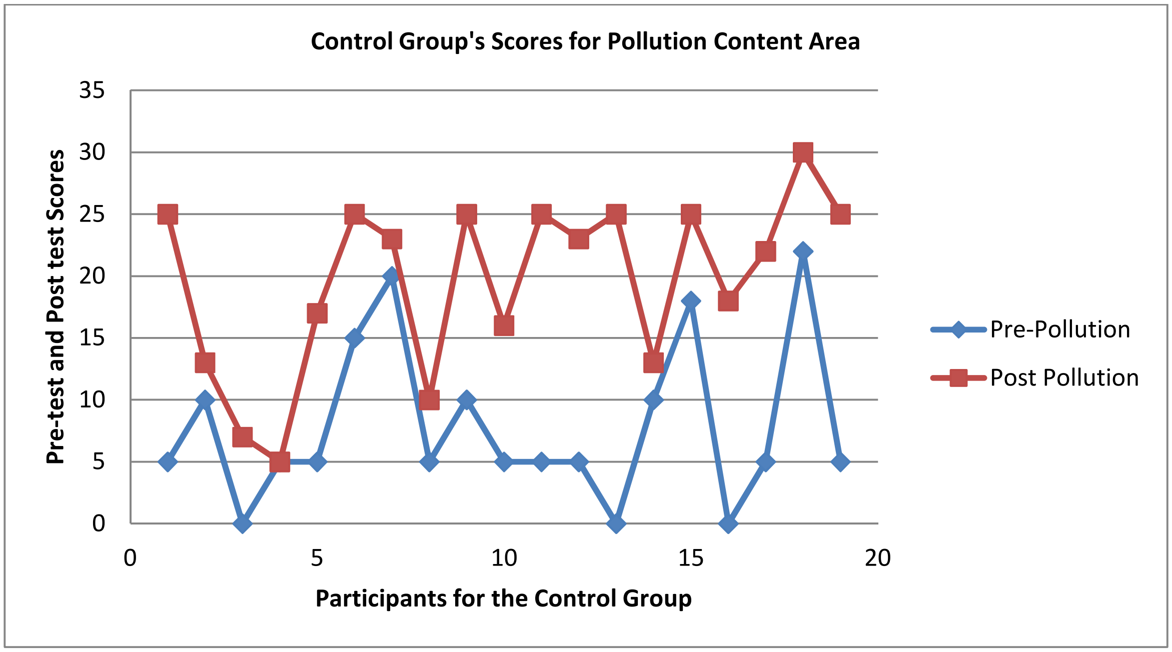

Figure 3. Control Group's Pre-Post Test Scores from the Pollution Content Area.

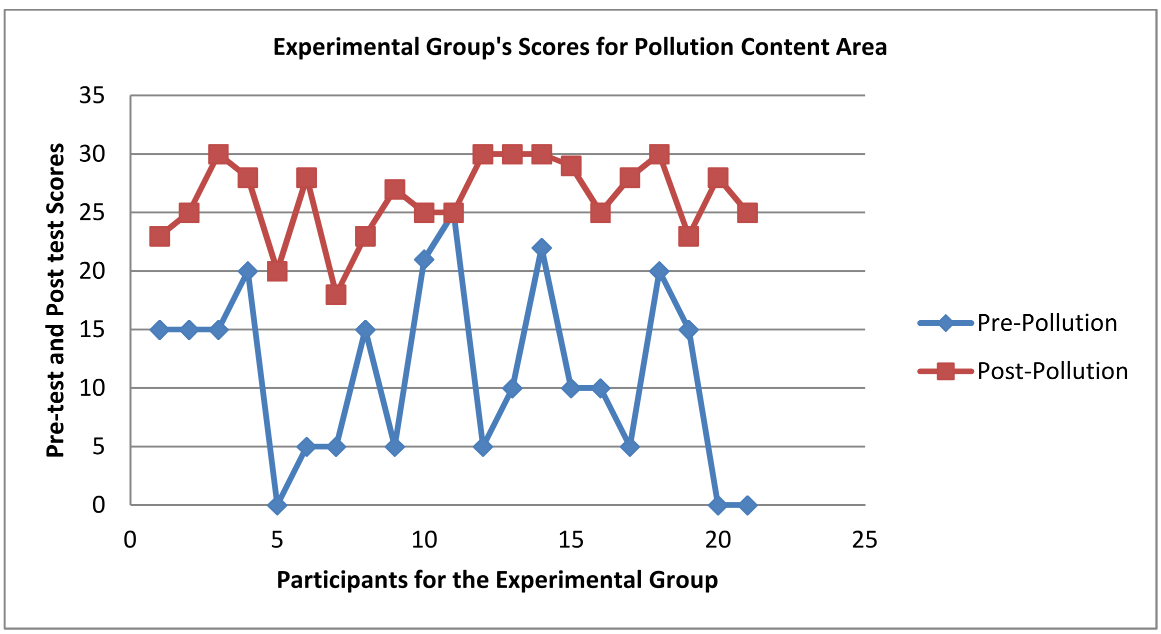

Figure 4. Experimental Group's Pre-Post Test Scores from the Pollution Content Area.

Conservation

An analysis of covariance (ANCOVA) was conducted on the 55 point conservation section of the Georgia Third grade Harcourt School Science Pollution and Conservation test. The first analysis of the data was the homogeneity-of-regression (slopes) assumption, which indicates the relationship between the covariate (pre-test) and the dependent (post-test) did not differ significantly as a function of the independent variable, $F(1, 38) = 1.706$, $p = .200$. The ANCOVA test was significant, $F(1, 38) = 11.56$, $p < .001$. The results showed that students in the experimental group ($M = 46.14$) had significantly higher scores on the Pollution and Conservation Test than control group ($M = 34.68$), controlling for pretest scores. The effects sizes for the groups were small using the Cohen's d the score obtained was 0.12. Figure 5 shows changes in the pre-test and post test scores on conversation section of the Pollution and Conservation test for each student in the control group. Figure 6 shows changes in the pre-test and post test scores on conservation section of the Pollution and Conservation test for each student in the experimental group.

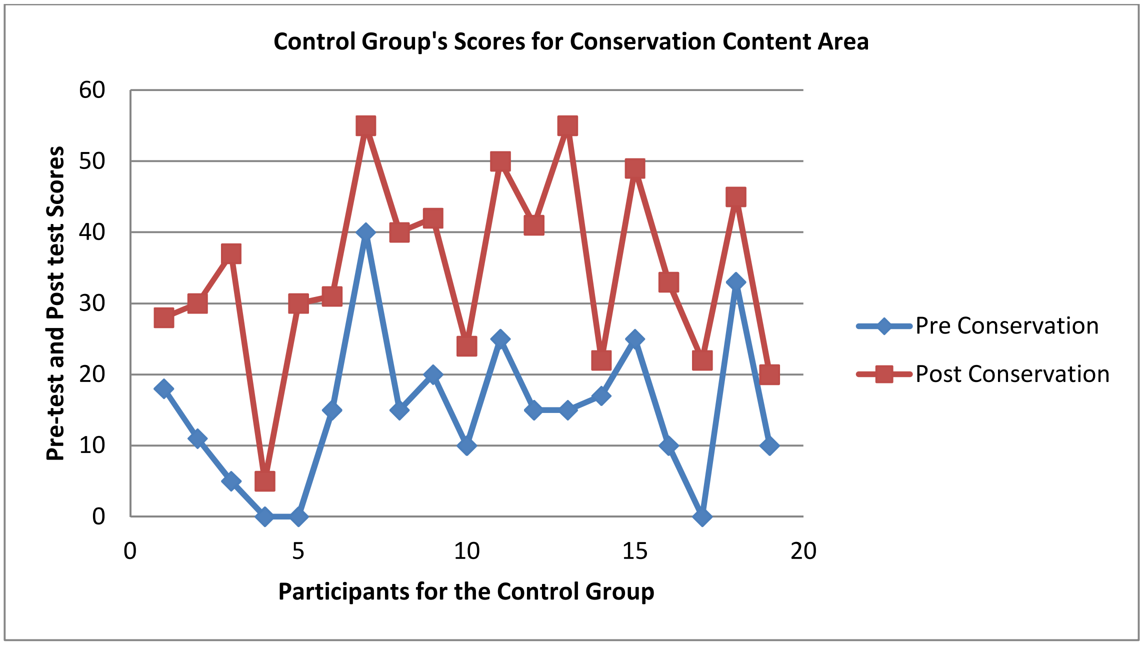

Figure 5. Control Group's Pre-Post Test Scores from the Conservation Content Area.

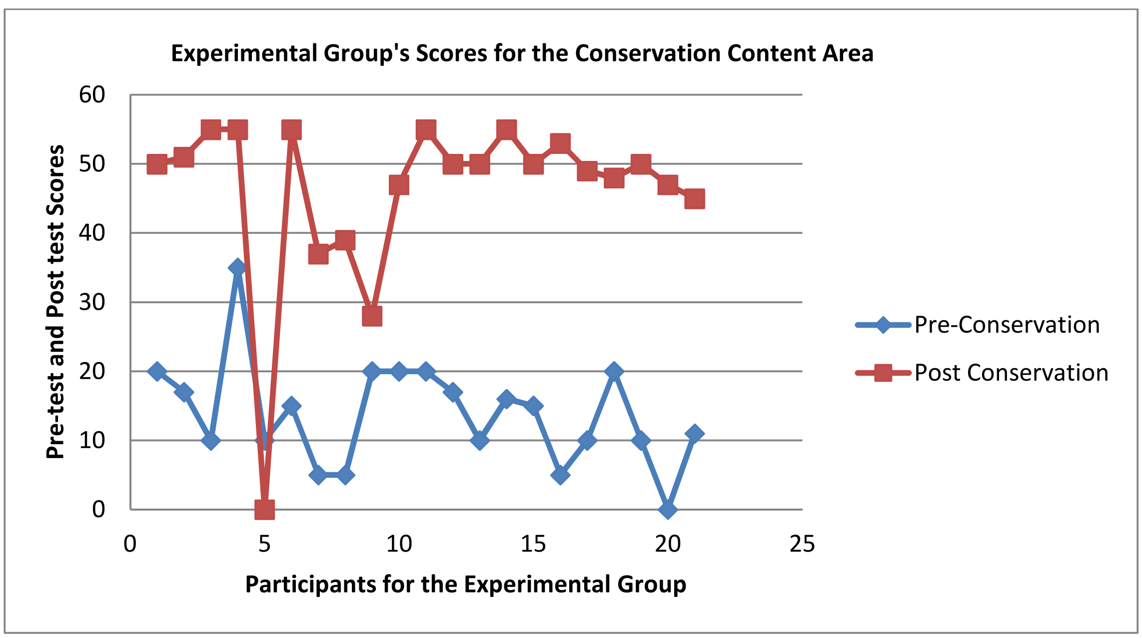

Figure 6. Experimental Group's Pre-Post Test Scores from the Conservation Content Area.

Recycling

An analysis of covariance (ANCOVA) was conducted on the 15 point recycling section of the Georgia Third grade Harcourt School Science Pollution and Conservation test. The first analysis of the data was the homogeneity-of-regression (slopes) assumption, which indicates the relationship between the covariate (pre-test) and the dependent (post-test) did not differ significantly as a function of the independent variable, $F(1, 38) = .003$, $p = .955$. The ANCOVA test was significant, $F(1, 38) = 4.18$ $p < .05$. The results showed that students in the experimental group ($M = 12.86$) had higher scores on the Pollution and Conservation Test than control group ($M = 10.00$), controlling for pretest scores. The effects sizes for the groups were very small using the Cohen's d the score obtained was 0.013. Figure 7 shows changes in the pre-test and post test scores on recycling section of the Pollution and Conservation test for each student in the control group. Figure 8 shows changes in the pre-test and post test scores on recycling section of the Pollution and Conservation test for each student in the experimental group.

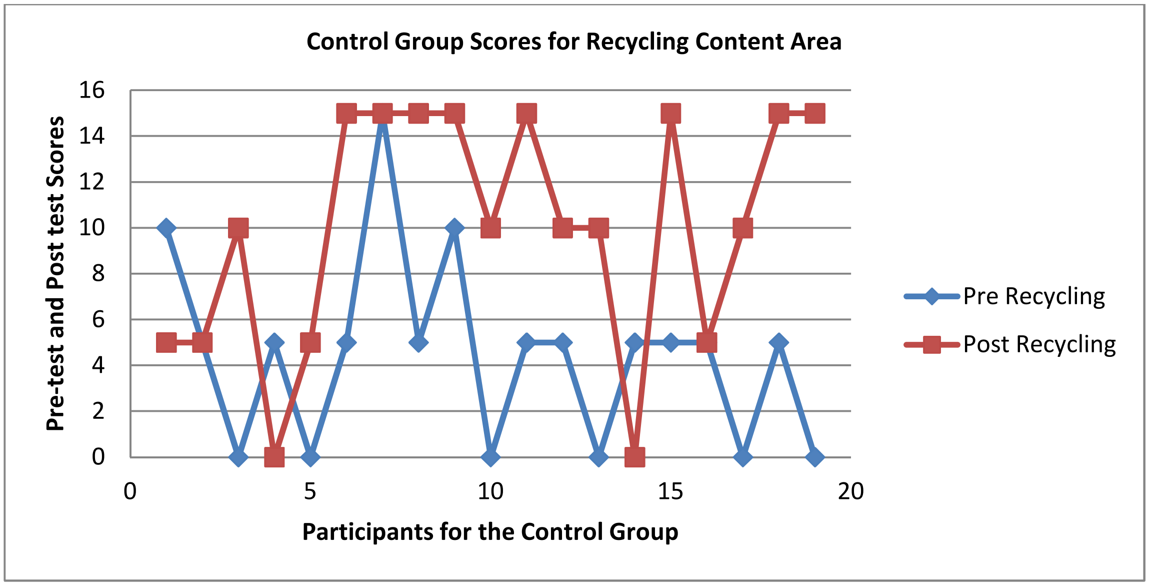

Figure 7. Control Group Pre-Post Test Scores from the Recycling Content Area.

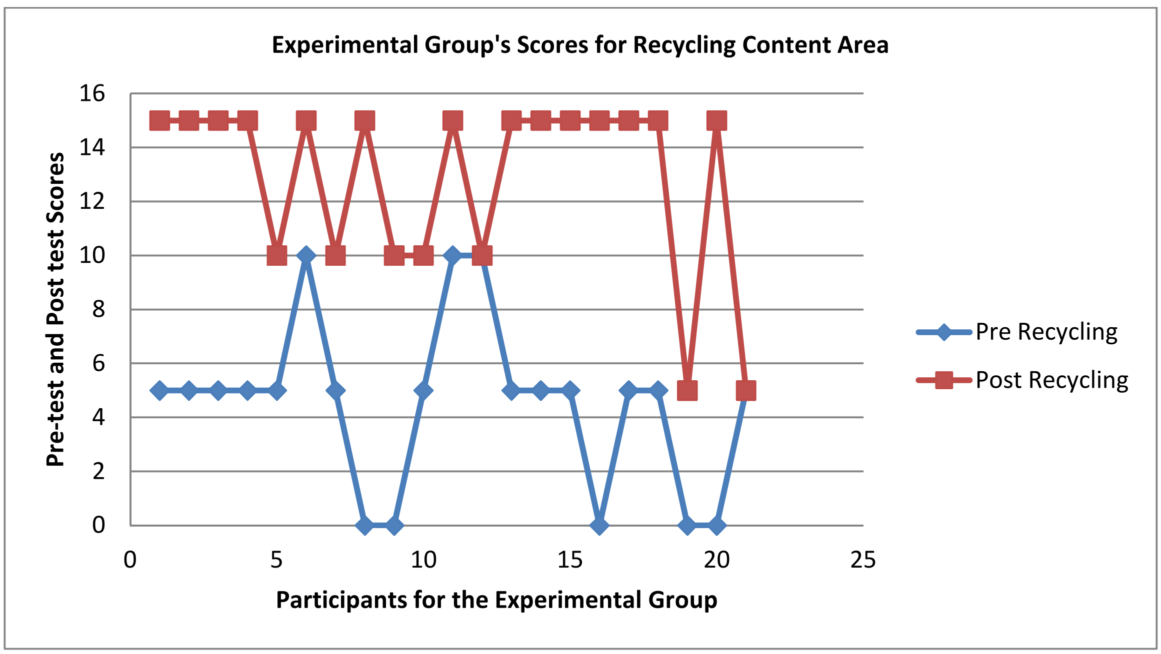

Figure 8. Experimental Group Pre-Post Test Scores from the Recycling Content Area.

Environmental Action Rubric-Revised

The Environmental Action Rubric-Revised was used to evaluate the quality of public service announcements developed during the three week unit of instruction about pollution, conservation, and recycling. Three third teachers sat together in the Family Engagement Room and rated the videotaped projects. First, the teachers reviewed the Environmental Action Rubric and discussed the three environmental categories for the public service announcement which were content (of the standards), organization (easy to understand), and presentation of the video (interest and information in the video). Then, the teachers reviewed the three grades of Exceeds the standards (3 pts), Meets the standards (2 pts), and Progressing toward the standards (1 pts). The categories were worth 3 points each, with a total possible score of 9. The requirement for this project was for students to exceed the standards on their public service announcements of the different topics of pollution, conservation, and recycling. This prerequisite expectation made certain that students had a final project with all the content vocabulary, content that others could understand, and a presentation that would hold audience attention. Next, the teachers watched the public service announcements. The teachers discussed their scores and calculated the scores for each group. The number scoring system and discussions were used to increase validity of the rubric and the interrater or intrarater was for the reliability. Then, they watched the public service announcements a second time to see if they were still in agreement on their scores. This process continued until they watched all three of the public service announcements and scored them. For the pollution public service announcement, the teachers gave the students a score of 9 points. The teachers rated the conservation public service announcement with a score of 9 points. For the recycling public service announcement, the third grade teachers gave the students a score of 9 points. All three announcements exceeded the standards in each of the categories.

The students also rated the public service announcements using the Environmental Action Rubric-Revised after they completed their projects. First, the students reviewed the Environmental Action Rubric just like they did during the three week unit of instruction about pollution, conservation, and recycling. Next, the students watched each video while the featured video group left the room. The students believed that this would allow them time to freely discuss the content of each public service announcement. When the group returned to the classroom, the other group discussed their rating scores. This process continued until all the videos were watched and discussed. For the pollution video, the students rated the public service announcement with 9 points, which exceeded the standards. For the conservation video, the students gave the group 9 points, which exceeded the standards. For the recycling video, the students rated the public service announcement with 9 points, which exceeded the standards. All groups received exceeding scores on the public service announcements.

Summary

The Pollution and Conservation unit test scores from both the experimental and control groups' achievement improved. However, the total score of the experimental group (M = 85.19) was significantly higher on the than the total score for the control group (M = 64.26). After analyzing the scores of the different section, the experimental group scored higher in the following areas of pollution (M = 26.19), conservation (M = 46.14), and recycling (M = 12.86) than the control group with scores of pollution (M = 19.58), conservation (M = 34.68), and recycling (M = 10.00). The graphs showed that pretest and post test scores for the control and experimental groups. The students scored 9 points using the Environmental Action Rubric-Revised, which means that they exceeded the rubric expectations on their public service announcements about the pollution, conservation, and recycling standards.

Research Question Two

Do third grade students' attitudes changed about pollution, conservation, and recycling as a result of using inquiry based learning?

To answer question two, the attitude scores for the New Ecological Paradigm Scale for Children (NEP-C) and the student interview were analyzed. An analysis of covariance was used to assess the NEP-C scores from both the control and experimental groups using the SPSS statistical software. The pre-test and post test scores were entered into the spreadsheet. The value of co-variance was checked along with the homogeneity of regression slopes. An analysis of covariance (ANCOVA) was conducted to determine if there were differences in total scores. The researcher entered the mean score and the standard deviation score from the experimental and control groups in the effect size calculator to determine the effect size. The charts were created by the research using the Excel spreadsheet for the pre-test and post test scores on the New Ecological Paradigm Scale for Children. The student interviews from both the control and experiment groups were coded and analyzed.

New Ecological Paradigm Scale for Children

A total of 40 students completed the survey New Ecological Paradigm Scale for Children after the conclusion of the unit with a scoring range of 0-50. There were 15 girls and 25 boys between the ages of 8 to 10 years old. The total score for the pre-test scores was 33.25 with a standard deviation of 5.0, which are reported in Table 15. For the control group, the mean score for pre-test was 32.84 with a standard deviation of 4.73.

For the experimental group, the mean score for pre-test was 33.62 with a standard deviation of 5.29. The total score for the post test scores was 37.03 with a standard deviation of 3.96, which are reported in Table 16. For the control group, the mean score for post-test was 34.74 with a standard deviation of 3.23. For the experimental group, the mean score for post test was 39.10 with a standard deviation of 3.42.

Table 15

Pre-test Scores for the NEP-C (revised)

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	control	19	32.8421	4.72891	1.08489
	experimental	21	33.6190	5.28655	1.15362
	Total	40	33.2500	4.98073	.78752

Table 16

Post-test Scores for the NEP-C (revised)

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest	control	19	34.7368	3.22907	.74080
	experimental	21	39.0952	3.41913	.74612
	Total	40	37.0250	3.95803	.62582

Both groups began the unit began with basically the same level of knowledge about pollution, conservation, and recycling. However, the experimental group scored higher on the post test than the control group. Figure 9 shows changes in the pre-test and post test scores on the NEP-C revised for each student in the control group. Figure 10 shows changes in the pre-test and post test scores on the NEP-C revised for each student in the experimental group.

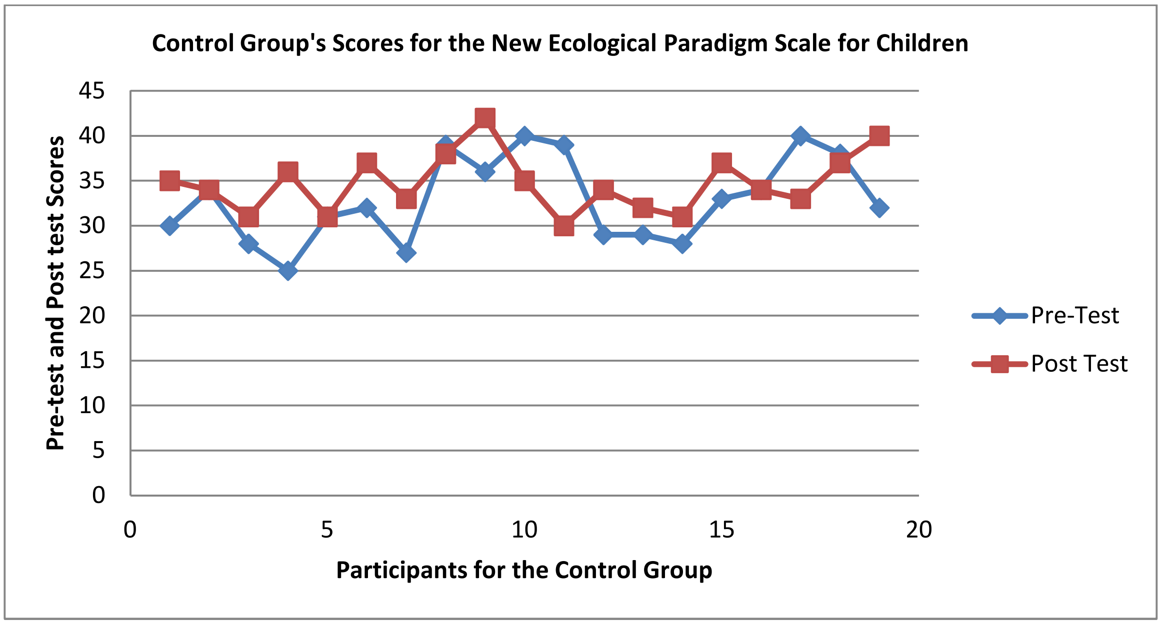

Figure 9. Control Group’s Pre-Post Test Scores for NEP- C.

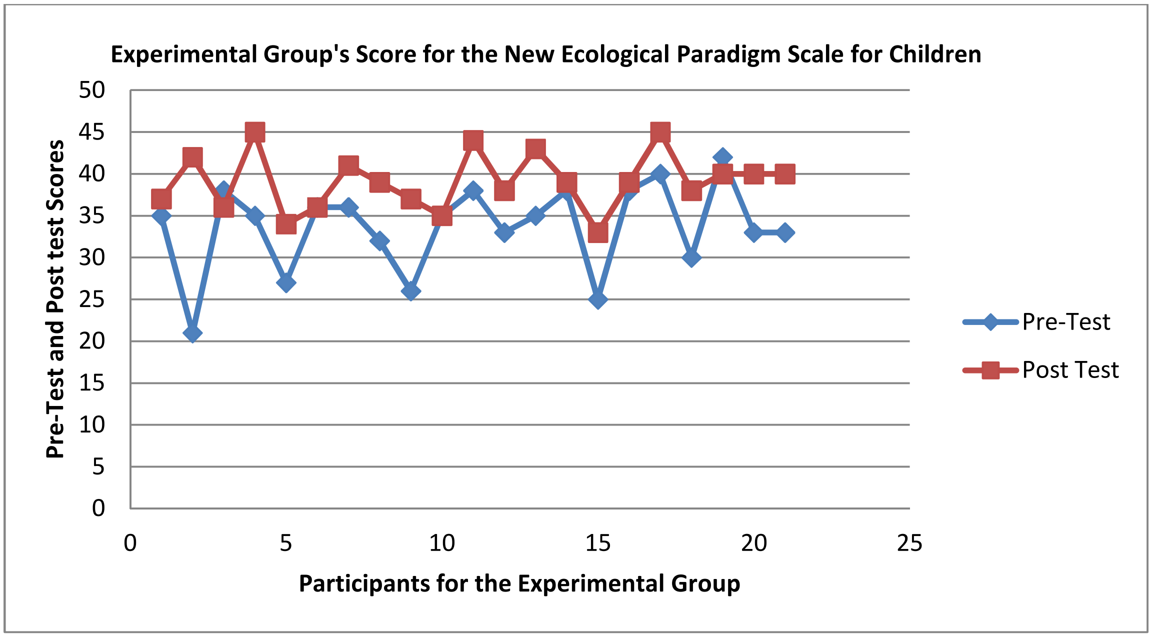

Figure 10. Experimental Group's Pre-Post Test Scores for NEP- C.

For this portion of the study, an analysis of covariance (ANCOVA) was conducted. The independent variable was instructional strategies for the third grade pollution and conservation science unit, which included traditional science lessons for the control group and inquiry based 4 strand learning practices for the experimental group to see if the attitudes of the different groups changed as the result of their instructional strategy. The variable was the control and experimental groups' post-test scores from the NEP-C and the covariate was the pre-test scores from the New Ecological Paradigm Scale for Children. The first analysis of the data was the homogeneity-of-regression (slopes) assumption, which indicates the relationship between the covariate (pre-test) and the dependent (post test) did not differ significantly as a function of the independent variable, $F(1, 38) = .091$, $p = .765$. The ANCOVA was significant, $F(1, 38) = 16.858$, p

$< .001$. The results showed that students in the experimental group ($M = 39.023$) had significantly higher scores on the New Ecological Paradigm Scale than control group ($M = 34.816$), controlling for pretest scores. The effects sizes for the groups were significant - using the Cohen's d the score obtained was 1.310.

Student Interview Questions

There were two student interviews conducted for this study. The interviews occurred after the completion of the pollution, conservation, and recycling unit. Two groups of five students were randomly selected from the experimental and control groups. The interviews were conducted to collect additional data to see if the attitudes about pollution, recycling, conservation, and technology changed as a result of the unit. The audio-taped experimental and control group interviews were listened to multiple times by the researcher to ensure accuracy of the transcripts. The researcher then made a list of the statements from the experimental and control transcriptions. The final product does not reflect the project instructions or expectations. The interviews demonstrated that the categories were pollution, conservation, recycling, and technology and the themes were the core of the students' statements (Merriam, 2009). The 10 participants in the interviews all participated in the 14-day unit.

Control Group's Interview

The control group interviews took place in a speech classroom during special areas. The children all seemed to be comfortable with the researcher. The group sat at a circular table and the children decided to go around the table and answer each question. The interviews were conducted similar to the Morning Meeting (these students are a part of a morning meeting each morning) or focus group format where the student took turns and shared their ideas and thoughts about each question. Table 17 represents the control groups' demographics from the interview questions.

Table 17

Control Group Interview Demographics

Student	Gender	Race
#1	Male	Hispanic/Latino
#2	Male	African American
#3	Male	Caucasian
#4	Female	Caucasian
#5	Female	African American

Table 18 represents the emerging meaning statements by unit content and technology categories for the control group.

Table 18

Emerging Meaning Statements by Categories for the Control Group

Category	Meaning Statements
Comments about Pollution	• I see people umm..litter and lots of trash on the ground around the places I walk. • I think that our community is polluted cause when I go to park. There's trash all over the flower beds. I saw aluminum bottles, paper, trash and I went over and picked it up. • I think that when people litter I think that it is not really good for plants. • Pollution is not a good thing.. the fish need to eat and water and oil is

	bad. • Tell them that if you pollute you'll be making plant die. • I would put up posters on like signs and stuff saying… Pollution's bad pick up trash. It's killing animals. • I also see that and think that they should either recycle it or throw it in the trash.
Comments about Conservation	• You should they need to turn off the light instead of leaving them on. • I think that if you are not using the electricity or water, you'll be wasting it so you need to turn it off. If you are not using it, you are wasting your resources. • If I was to notice it, I would go get the person and say go turn off the lights. You're wasting power and electricity. • That you are going to have to turn off the water and turn off the TV when you like leave. • If somebody had a big house and they had a huge TV in there and they kept it on all day and they weren't watching it. That would make their bill go higher and higher
Comments about Recycling	• You'll just really need to recycle. • We should recycle it. Like recycle cans in the right place and put paper in the right place and put stuff in the recycling. • I think they should pick up the trash when they like throw it and should recycle it. • We should do more recycling. • I am for more recycling.
Comments about Technology	• Happy, it's fun. • I like it. • With technology, we should just learn what we need to learn. • Umm, I will like if we are doing a test on something and I get done. • I'm kinda in the middle. I like having a hands-on, do-it yourself but I also like getting on the computer and having fun. • I like to control my own stuff. I like doing my own.

Emerging meaning statements were coded to identify categories with the statements. The categories were re-examined for themes in the students' comments (Merriam, 2009). Table 19 represents the themes from each category.

Table 19

Control Themes for Pollution, Conservation, and Recycling

Categories	Themes
Pollution	• Our community is polluted since many people are throwing their trash on the ground. • Pollution is bad and it killing plants, animals, and fish. • People should be put in trash cans or recycling bin.
Conservation	• Turn off lights when you leave a room or you will pay higher bills. • Turn off water your water.
Recycling	• People should recycle their trash. • Put trash in the right place by recycling it.
Technology	• Technology is fun and enjoy using it when I am done with my work. • I like being of control of my learning.

The general themes in each category were identified. For pollution, students believed pollution was a problem in their community. One student said, “I see people umm..littering and lots of trash on the ground around the places I walk.” Another child stated, “I think that our community is polluted cause when I go to park. There’s trash all over the flower beds. I saw aluminum bottles, paper, trash and I went over and picked it up.” For conservation, the students felt that the people need to turn off the lights, computers, and water. At first students couldn’t remember what the definition was for conservation and then the students remembered. One student declared, “You could turn technology off and not using it.” Another student stated, “When we are done and just playing around on games I think we should cut it off.” For recycling, the children thought that people need to recycle their items. One student said, “When people litter, I think that they should put it in the recycling place or put it in the trash.” Another child stated, “I think they should pick up the trash when they like throw it and should recycle it." For technology, students believed that technology is primarily a reward. One child stated, "I will like if we are doing a test on something and I get done." Another student said, "I also like getting on the computer and having fun."

Experimental Group's Interview

The experimental group interviews took place in their classroom during their special area time. The children were all comfortable with the researcher since the researcher was their teacher but they voiced that they didn't like audio taping because they didn't like hearing their own voices. The group sat at a kidney table and the children decided to go around the table and answer each question. They decided that this gave all the participants a chance to share and be heard. The interviews were conducted similar to the Morning Meeting (these students are a part of a morning meeting each morning) or focus group format where the student took turns and shared their ideas and thoughts about each question. Table 20 represents the experimental groups' demographics from the interview questions.

Table 20

Experimental Group Interview Demographics

Student	Gender	Race
#1	Male	African American
#2	Female	Caucasian
#3	Male	Caucasian
#4	Female	African American
#5	Male	Hispanic/Latino

Table 21 represents the emerging meaning statements by unit content and technology categories for the experimental group.

Table 21

Emerging Statements by Categories for the Experimental Group

Comments about Pollution	• I learned that you could die from pollution and that animals and living things could die just from people littering and stuff. • That pollution is not good because it could mean smoke is in the air like birds are up there and it could mean that stuff and some people could die and animals and other things. • I might tell my friends and family members that it's bad because if we do air pollution like factory shut down and stop putting smoke into the air. • We can persuade our friend by saying that it's not good and animals will die if you don't stop littering and stuff. • We need not drive anymore cars or we could like buy skateboards or other things. • I think if the people saw our video that if they kinda littered a lot that they would kinda think twice. • Some people you teach easily but some would never listen.
Comments about Conservation	• If they don't conserve resources their bills might go high. • Your water bill will go higher and I will tell them to conserve water like when if you are showering, don't stay in the shower too long. • Please turn the water off. That's not conserving water and Mommy and Daddy will have to pay a whole lotte of money if you don't. • I think so that we could take showers but like less time or hurrying up. Or don't using too much electricity or use less water.
Comments about Recycling	• Now I always check to make sure that the material is recyclable by the number on the bottom. • When we went on the field trip, I saw that it is more important to recycle then put it in the trash. • Since we went on that field trip to the recycling center, I know how to recycle even more. • If they saw the video, they could learn and think more about recycling and not polluting and stuff. • I can't recycle because we don't have a recycle thing that we can't recycle. That's the hard part. But I don't know if we can recycle.
Comments about Technology	• The I-pad really helped.. um.. well it is a way to organize your thoughts and stuff. • Being recycling man was really cool and it taught me a lot about recycling I thought that using the technology …helped me a lot. • I think that it was great. • That umm, we can <pause> well, it teach me that about recycling, conservation, and pollution. • Well, I think that I was a really fun way to learn. • I like science better this way but I think science this way and making our video was cool. • Well, I guess that the one thing probably that I didn't like <pause> that's hard.

Emerging meaning statements were coded to identify categories with the statements. The categories were re-examined for themes in the students' comments (Merriam, 2009). Table 22 represents the themes from each category.

Table 22

Experimental Themes for Pollution, Conservation, and Recycling

Categories	Themes
Pollution	• Our community is polluted. Animals and plants are dying. • Our land and water are polluted with trash. Air is polluted with smoke and it is making people sick.
Conservation	• Conserving resources help you save money. • Turn off water and light when you are not using them.
Recycling	• We are recycling more since the field trip. • Our families are checking items for the numbers to recycle them.
Technology	• Technology helps us organize our thoughts. • The videos we made should help people think twice about pollution, conservation, and recycling.

The general themes in each category were identified. For pollution, students believed pollution is in their community and in their water, land, and air. One child stated, "Well, I do think there's lots of pollution because like I see trash all over the ground." Another student said, "I learned that you could die from pollution and that animals and all living things could die just from people littering and stuff." A third child stated, "That pollution is not good because it could mean smoke is in the air like birds are up there and it could mean that stuff and some people could die and animals and other things." For conservation, the students thought that conserving resources would save a person money.

One student said, “if they don’t conserve resources their bills might go high.” Another student said, “we could take showers but like less time or hurrying up.” For recycling, students believed that they had been recycling more since the field trip. One student said, “I recycle at my house and since we went on that field trip to the recycling center. I know how to recycle even more.” Another student said, “I always check to make sure that the material is recyclable by the number on the bottom.” For technology the student felt that the technology was beneficial for making the pollution, recycling, and conservation public service announcements. One student declared, “The iPad really helped to organize your thoughts and stuff.” Another student stated, “Being recycling man was really cool and it taught me a lot about recycling I thought that using the technology. . . helped me a lot.”

Summary

This chapter presented the results for the quantitative and qualitative data analyses used to answer the research questions. Data revealed that both experimental and control group scores improved. On the Pollution and Conservation Unit Test, the experimental group mean score for post-test was 85.19 and the control group mean post test score was 64.26. Student interviews revealed that both groups learned environmental concerns were problem in our community. However, the experimental group provided more in-depth analyses. One student in the control group stated, “I think that our community is polluted cause when I go to park. There’s trash all over the flower beds. I saw aluminum bottles, paper, trash and I went over and picked it up.” A student from the experimental group said, “We can persuade our friend by saying that it’s not good and animals will die if you don’t stop littering and stuff.” With regard to conservation, a student from the control group declared, “That you are going to have to turn off the water and turn off the TV when you like leave.” One of the experimental group students stated, “Your water bill will go higher and I will tell them to conserve water like when if you are showering, don’t stay in the shower too long.” When talking about recycling, a student from the control said, “I think they should pick up the trash when they like throw it and should recycle it.” A student from the experimental stated, “Now I always check to make sure that the material is recyclable by the number on the bottom.” Both groups were able to generalize what they learned to apply their new knowledge to their everyday lives.

According to their scores on the New Ecological Paradigm Scale for Children, the control and experimental group scores improved. On the NEP-C, the control group post-test mean score for was 34.74 and the experimental group post-test mean score for was 39.10. The themes from the student interviews reinforce the students’ experiences during the Pollution and Conservation Unit that they learned the importance of recycling and conservation to cut down on the amount of pollution in our community. However, students from the experimental group believed that their public service announcements could change people’s mind about pollution, conservation, and recycling to be more proactive in disposal of their personal waste. One student in the experimental group states, “If they saw the video, they could learn and think more about recycling and not polluting and stuff.” Another student believed, “However, students from the experimental group believed that their public service announcements could change people’s mind about pollution, conservation, and recycling to be more proactive in disposal of their personal waste. One student in the experimental group states, “If they saw the video, they could learn and think more about recycling and not polluting and stuff.”

Overall, the results demonstrated that the experimental group’s method of inquiry based instruction using the National Research Council’s four strands for scientific practices as a learning cycle improved achievement scores along with their attitudes about the environment. When students followed the scientific practices of (1) understanding scientific explanations, (2) generating scientific evidence, (3) reflecting on scientific knowledge, and (4) participating productively in science (NRC, 2007), they created public service announcements that included the content and vocabulary of the standards, organization, and presentation of video.

CHAPTER 5

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

"To look and to see, to stand up and be counted, to dream, to listen, to accept disequilibrium, to act, to doubt, and to act again. And to stand with my students as they see and begin to feel the weight of the world for themselves"

-Ayers, 2004, p. 136

Children need to experience the Georgia Performance Standards' holistically for themselves to truly understand what they are learning. The four strands for science learning practices, developed by the National Research Council, provide students with a framework to develop their own knowledge by producing a product after they have broken down the standards, researched a topic, and reflected on the information. Children should be actively engaged in scientific inquiry practices to truly understand the scientific concepts. William Ayers (2004) recapitulated the new role of the teacher in the experimental group when he wrote, "In dialogue, the teacher becomes the student of her students, and the students become the teachers of their teacher. Lines are blurred, authority subverted, a new journey undertaken" (p. 136). The future role for a science teacher is a facilitator that allows students to find themselves a place in the world for discovery. This chapter discusses the findings and conclusions of this study, along with existing research as it relates to the research questions, implications, and final recommendations for future research.

Research Questions

The overarching research question for this inquiry-based study was, "What was the impact on third grade students' achievement and attitudes when integrating inquiry–based learning with a technology-based public service announcement component in a pollution, conservation, and recycling unit?" This question was broken into two parts:

1. Are there differences between third grade students' achievement scores as a result of using inquiry-based learning when teaching the pollution, conservation, and recycling unit?
2. Do third grade students' attitudes about pollution, conservation, and recycling unit change as a result of using inquiry-based learning?

Research Question One: Are there differences between third grade students' achievement scores as a result of using inquiry-based learning when teaching the pollution, conservation, and recycling unit?

Pollution and Conservation unit mean test scores from the experimental and control groups improved from the pre-test (M = 28.58) to the post test (M = 75.25) out of a total score of 100 points. However, the post-test mean score from the experimental group (M = 85.19) was significantly higher than the control group post-test mean score (M = 64.26). Students in the experimental group also scored higher scores on the Pollution and Conservation test sections of pollution (M = 26.19), conservation (M = 46.14), and recycling (M = 12.86) than the control group on the pollution (M = 19.58), conservation (M = 34.68), and recycling (M = 10.00). These scores suggest that the experimental group using the inquiry-based learning, National Research Council's four strands of science learning practices benefitted from this type of instruction more than the students in the traditional science lesson. According to the statements from the student interviews, both the control and experimental groups believe that can make other aware of environmental concerns. One student from the control group stated, "I would put up posters on like signs and stuff saying… Pollution's bad pick up trash. It's killing animals." A student from the experiment group said, "We can persuade our friend by saying that that not good and animals will die if you don't stop littering and stuff." After the completion of the pollution and conservation unit, the students from both groups are more conscious of pollution and how it affects humans as well as animals.

The scores from the experimental group on the Environmental Action Rubric-Revised exceeded standards on their public service announcements. Three third grade teachers scored the public service announcement and the teachers graded them using rubrics denoting that students used their vocabulary, organized their products, and were aware of their audience. One student said during the interviews, "I think if the people saw our video that if they kinda littered a lot that they would kinda think twice." Another student stated, "If they saw the video, they could learn and think more about recycling and not polluting and stuff." The public service announcement gave the students a venue to show others the importance of recycling to stop pollution. The pollution, conservation, and recycling groups all scored a perfect score of 9 on their final products. The requirement for this study was for all three groups to score a total score of 9. However, if this was not a requirement of this study, does this mean the Environmental Action Rubric-Revised domains were not rigorous enough for the public service announcements? The third grade teachers may need to revisit the rubric to make the needed adjustments.

Research Question Two: How have third grade students' attitudes changed about pollution, conservation, and recycling unit as a result of using inquiry-based learning?

New Ecological Paradigm Scale for Children data analysis found students in the experimental and control groups changed their attitudes about environmental issues as a result of the teaching of the unit. Experimental group post-test mean score (M = 39.10) was significantly higher than the control group post-test mean score (M = 34.74). From the student interviews, one student from the experimental group said, "I think so that we could take showers but like less time or hurrying up. Or don't using too much electricity or use less water," Another student from the control group said, "I think that if you are not using the electricity or water, you'll be wasting it so you need to turn it off. If you are not using it, you are wasting your resources." Students were more aware of the environmental issues in their community and believe that they could change the minds of friends and family about saving resources.

Student interview question data analysis found that students in the experimental group were more confident about their answers than the control group. The experimental groups knew all the vocabulary words and were able to discuss all the topics. The control group had to ask the meaning of different vocabulary words. Both groups learned the main concepts from the lessons. The main area that the control and experimental groups discussed was the effects of pollution on humans and animals. Students stated that conservation and recycling were alternatives to the pollution. The experimental group expressed solutions for the environmental problems while the control group had difficulty remembering content vocabulary.

Conclusions

The findings of this study indicate that inquiry-based learning with a technology component had an impact on student test scores and attitudes. The invention was a 14 day instructional unit that included 40 third grade students in two groups. Both the experimental and control groups improved and demonstrated an understanding of the pollution, conservation, and recycling. However, the mastery level was different, with a mean score from the experimental group (M = 85.19) and a mean score from the control group (M = 64.26). Students in the experimental group scored significantly higher on the Pollution and Conservation Test and New Ecological Paradigm Scale for Children (revised) using the ANCOVA. Interview data demonstrated that the experimental group had more in-depth knowledge and holistic understanding of the concepts following the invention. The public service announcement was a mechanism for student to critically examine their environmental concerns.

Inquiry-based learning processes allow children to discover and create their own understanding of what they are learning, which has been found to be important. Dewey (2001) posited

> If the aim of historical instruction is to enable the child to appreciate the values of social life, to see in imagination the forces which favor and let men's effective cooperation with one another, to understand the sorts of character that help on and that hold back, the essential thing in its presentation is to make it moving, dynamic. (p. 96)

Inquiry-based learning strategies in science has been previously demonstrated to improve science instruction. The control group used the pre-planned curriculum, which included experiments, reading from a textbook, and a science workbook. This finding supports the Minogue et al. (2010) study that used a science notebook and the four strands for science learning practices to improve science scores. Significant differences were found between control and experimental groups mean total scores and domain scores (pollution, conservation, and recycling). Both groups improved. This finding supports Harris' (2009) study that traditional third grade instruction in combination with inquiry based learning improves students' understanding of the standards.

For this study, third grade students used the inquiry process of four strands of science learning as a learning cycle to find solutions for environmental problems. The experimental group used the National Research Council's four strands of science learning practices: (1) understanding scientific explanations; (2) generating scientific evidence; (3) reflecting on science knowledge; and (4) participating productively in science (NRC, 2007). This process was similar to the learning cycle create by Robert Karplus (1964) and Roger Bybee (1997). Karplus' (1964) three learning cycle phases are exploration, invention, and expansion of the idea. Roger Bybee's (1997) learning cycle to include five steps: (1) Engagement; (2) Exploration; (3) Explanation; (4) Elaboration; and (5) Evaluation. Both learning cycles included exploration. The other phases in both learning cycle provide students with a framework to investigate and develop conceptual understanding of new knowledge.

However for this study, the National Research Council's four strands of science learning practices were used. The students broke down the standards for pollution, conservation, and recycling to understand the scientific explanations. The standards used for this study were the current Georgia Performance Standards. The Next Generation Science Standards had not been adopted by the state of Georgia at the time of the study. Next, students researched topics with their netbooks to generate scientific evidence. Then, students used their researched information to write a script, create a setting, and edit the script to reflect on their scientific knowledge. After reflecting on the scientific data they gathered, the students decided that a public service announcement was a good way to productively communicate their ideas and interpretations of that data. The rationale for selecting the National Research Council's four strands of science learning practices was that it afforded the students a process to discuss and consistently reflect on what they have learned. It also provide them with the ability to research more about a topic if their reflections result in more questions to be researched.

Ecopedagogy embraces the ideas of social interaction, of cooperative learning, environmental education, and didactic problem solving, which is an important component of this study. Kahn (2010) explained, "ecopedagogy should therefore aspire to become a movement of dialogue amongst various sustainability movements, allowing them to learn from one another and organize in a transitional alliance" (p. 57). When students are actively engaged in environmental education lessons, they are more willing to become stewards for the environment (Shanely, 2006). This study supports Shanely's (2006) assertion. Students were able to critically examine and discuss the content of the topics in the both the experimental and control groups. NEP-C attitude mean scores increased for both groups imply that the curriculum had an impact on their understanding of the environment. Additionally, the experimental group created a public service announcement. Through the creation of the public service announcements, the students were able to create a product to teach others about effects of pollution on the habitats of plants and animals, conservation of resources, and recycling of materials. Identically, all students scored the maximum on the Environmental Action Rubric Revised. Pollution and Conservation pre-post test mean scores indicated that students in the experimental group had a more in-depth understanding of pollution, conservation, and recycling. Both curriculums appear to have provided opportunities for students to critically examine environmental concerns however, the experimental curriculum, with its enhanced focus on inquiry, provided a much more in-depth critical analysis.

Attitudes about science change as a result of some action, whether it is positive or negative, and is not random (Koballa, 1988). This study supports this assertion in that pre-designed curriculums did impact attitudes about science according to NEP-C mean scores. This is similar to Osborne & Collins' (2003) claim that student interest is linked to curriculum being more interesting and relevant. If students find science interesting, their attitudes would be more positive about science. Students in this study were able to use inquiry-based learning and scientific practices to develop their own understanding of environmental issues and create a public service announcement to change the minds of others about pollution, conservation, and recycling. The New Ecological Paradigm Scale for Children (revised) provided concrete proof that students changed their attitudes. Results from questionnaires and surveys could be used for improvement of instruction to understanding students concerns about the environment (Mutisya & Baker, 2011; Naquin et al., 2010; Rocas et al., 2009).

Technology is a conceptual tool for children to communicate, persuade, and teach others what they have learned (Sandholtz et al., 1997). Technology affords students an avenue to explore the scientific concepts taught in the classrooms (Bosseler, 2005; Chang et al., 2011; Hickey et al., 2002). For this study, students were able to use netbooks to understand their topics and to find additional information. Then, they were able to utilize I-pads to create videos with the I-movie, organize the data, edit the information, and finally, produce a product that captured their understanding of the content. Technology should be used in conjunction with inquiry-based learning to improve scientific knowledge (Layman et al., 1996). This study supports Hickey et al. (2002) and Chang et al. (2011) findings that students should use technology to inquire about a topic, to engage in scientific activities, and to develop scientific literacy.

Implications

Implication for Theory

The data from the Pollution and Conservation Test, Environmental Action Rubric, New Ecological Paradigm Scale Survey for Children, and student interviews provided several implications about the inquiry-based learning four strands practices. First, the 4 strands for science learning practices, is a valuable learning cycling process for students to use to derive understanding from the standards. Teachers need to make a poster with a list of the four strands and post it on the wall. Students are then able to refer to it when needed. During study, students used the poster as a guide to help them through the learning process. The daily opening and closing assisted students with reflecting on what they learned and provided them with future steps. As a result, students created a final product that conveyed what they have learned.

Second, at the time of defense of this dissertation, Georgia had not approved or endorsed the Next Generation Science Standards. Since Georgia was a member of the 26 state partnerships that created the Next Generation Science Standards, the new science standards for Georgia will probably be a combination of *A Framework for K-12 Science Education,* published by the National Research Council, and Next Generation Science Standards. The developers of the new standards provide students with three dimensions to understand the standards, which are content, practice, and crosscutting themes. The content is core ideas of science. Crosscutting is about applying scientific principles across science domains. The practice is the methods for engaging students in scientific investigation. The practice dimension was used in this study and students were actively engaged while using the four strands for leaning science.

Third, science attitudes are important to monitor. Students were able to decide or choose to like science along with wanting to do something to change the current environmental problems. As a result, children actively changed their minds about what they learning about environmental problems. This is not a random decision, but one of experience.

Fourth, ecopedagogy affords students with social interaction to critically discuss environmental issues such as the effects of pollution, conservation of resources, and recycling of materials. Students used the Environmental Action Rubric-Revised as a guide to identify solutions for environmental problems. They used the content vocabulary to explain their ideas, organize the material, and focus on the content for their audience.

Finally, technology is a crucial tool for children to understand scientific concepts. Students used netbooks to research topics and write scripts for their public service announcements. Then the iPad iMovie program provided students with technology to videotape, edit, organize, and publish their final product. It also afforded student time to reflect on what they learned and identify solutions of environmental issues.

In conclusion, the implications of this study are applicable to a variety of stakeholders in education. Science educators, curriculum developers, elementary school teachers, and environmental educators would all be interested in this research because it addresses areas of need in education. Each stakeholder would benefit more from the following highlights for the implementation of inquiry-based learning in classrooms.

Implications for Practice:

The findings of this study have implications for differing groups that are involved in science education. These groups are science educators, school-district curriculum directors, principals, and elementary science teachers. Implications for each group are as follows:

Science Educator

- Additional research in inquiry-based learning at the elementary school level based on the findings of this study.
- Rubrics provide students with a guideline to ensure that all content of the standards is included in the scientific understanding.
- Integrating technology to further knowledge of student learning of science concepts.

School District Curriculum Directors

- Using ecopedagogy as a paradigm for designing science curriculum so that students can critically examine environmental issues.
- Professional development about the use four strands of science learning practices as a learning cycle would provide teachers with the support needed for implementation in the classroom.

Elementary School Teachers

- The 4 strands of science learning practices equip students with learning cycle to investigated different scientific concepts.
- Collaboration with others lends itself to better understanding of how to provide and improve science instruction along with writing rubrics for science.

- Technology should be used for research and other creative project or products.

Environmental Educator

- Develop grant opportunities for educators to create lessons or units that address the standards using the 4 strands for science learning practices for the environment.
- Develop a website for educators to have access to the innovative lessons and units using the 4 strands for science practices for the environment.

Recommendations for Future Research

The findings from this study demonstrate that 21 third students were able to generate a product using a rubric after they broke down the standards, researched a topic, and reflected on their research. These findings also provide evidence that inquiry-based methods improved the achievement scores of the participants, along with attitudes about pollution, conservation, and recycling. While the findings for this study were focused primarily on the scientific concepts of pollution, conservation, and recycling, more research could be done. Future research about the four strands scientific strands of inquiry, especially at the elementary level, along with student's attitudes towards science could provide the teachers with the understanding they need to increase scientific knowledge in elementary schools. The motivation for the elementary science behind this type of focus is that students need to have a strong foundation of science at an early age so they are willing to foster their understanding as they mature.

The first way to build upon this research is to expand the study to include other content areas in science. The four strands for science learning practices are a framework to increase scientific literary. The practices of: (1) understanding scientific explanations;

(2) generating scientific evidence; (3) reflecting on scientific knowledge; and (4) participating productively in science could be used with instruction for physical sciences; life science; earth and space sciences; and engineering, technology, and applications of sciences. With the release and the implementation of the Next Generation Science Standards, more in depth studies could be conducted using these scientific practices with all standards, especially environmental standards.

Another way to build upon this study is to examine the four strands of science learning practices and attitudes about science over time with a longitudinal study. This study was conducted over a three week period, which is a relatively short amount of time for instruction. This would also afford the students, teachers, and researcher with time to delve into understanding the topics to a greater extent. Researchers would also be able to perform more student interviews to know if students' attitudes towards the environment are changing because of the scientific practices with the use of technology. The environmental units could be taught at the beginning of the year for the third through fifth grades. Researchers could expand their study to a year to identify their attitudes and understanding about pollution, conservation, and recycling through their environmental practices of developing and sustaining a recycling program.

A third way to build upon this study would be to include more subjects in the study. Additional students in a specific grade, across grade levels, or across different schools would provide researchers with other perspectives about the effectiveness of the scientific practices. An increase in students or subjects for the study would make available the progression of the implementation of the scientific practices as they relate to the science standards over a period of time.

A possible list of research questions for future study could include:

1. How do students' attitudes differ as a result of using inquiry-based learning in all science content area?
2. How do students' attitudes about pollution, conservation, and recycling improve as a result of using inquiry-based learning over time?
3. What is the difference in students' achievement scores about science as a result of using the 4 strands of scientific practices?
4. Does the use of technology improve students' science attitudes scores as a result of using the 4 strands of scientific practices?"

A fourth way to build upon this research would be to conduct this study at a variety of schools with different demographics. The school, where this study was conducted, is located in a school district with a very progressive technology budget and technology is featured in all the classrooms. It would be interesting to see if similar results would be obtained at other elementary schools with a different population as well as if technology is a necessary tool for the implementation of inquiry-based learning.

Summary

This study sought to answer the following question, "What was the impact on third grade students' achievement and attitudes when integrating an inquiry-based learning and technology-based public service announcement component in a pollution, conservation, and recycling unit?" This question was broken into two parts:

1. Are there differences between third grade students' achievement scores as a result of using inquiry-based learning when teaching the pollution, conservation, and recycling unit?

2. How have third grade students' attitudes about pollution, conservation, and recycling change as a result of using inquiry-based learning?

The epistemological theoretical frameworks used to answer the research questions were inquiry-based learning, ecopedagogy, and technology. Inquiry-based learning process was accomplished through the usage of the four strands of science learning practices by the teaching of the environmental standards. The students demonstrated their understanding of the standards by producing public service announcements that exceeded the standards. This study demonstrated that inquiry-based learning methods increase achievement scores and change attitudes about pollution, conservation, and recycling. Students in this study believed that their public service announcements could provide people with alternatives to pollution that affect humans and animals. Consequently, the inquiry-based learning or the four strands of scientific practices would be a more highly preferred teaching method for students than traditional textbook lessons. Science educators, curriculum developers, elementary school teachers, and environmental educators, along with school and county administrators, should use professional development groups, classes, and funding opportunities that feature the scientific practices.

Ecopedagogy was also a theoretical framework for this study because it provided a way for students to have social interaction with their classmates and to critically discuss environmental issues. The data obtained from the Pollution and Conservation Test, New Ecological Paradigm Survey for Children, student interview questions, and Environmental Action Rubric-Revised demonstrated that when students are allowed to use four strands of science learning practices, they can find solutions for environmental problems.

Technology was used to understand environmental concepts and identify solution for different environmental problems in our community. The students in the experimental group created a public service announcement about one of the topics of pollution, conservation, and recycling. The technology allowed them to research topics, organize their ideas, reflect on their understanding, and produce a product. These same students have now become stewards of the planet and our community.

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APPENDIX A

INSTITUTION OF REVIEW BOARD LETTER

Georgia Southern University
Office of Research Services & Sponsored Programs

Institutional Review Board (IRB)

Phone: 912-478-0843
Fax: 912-478-0719
IRB@GeorgiaSouthern.edu
Veazey Hall 2021
P.O. Box 8005
Statesboro, GA 30460

To:	Lori Jackson Dr. Gregory Chamblee
cc:	Charles E. Patterson Vice President for Research and Dean of the Graduate College
From:	Office of Research Services and Sponsored Programs Administrative Support Office for Research Oversight Committees (IACUC/IBC/IRB)
Date:	12/10/12
Initial Approval Date:	12/10/12
Expiration Date:	05/0[illegible]/13
Subject:	Status of Application for Approval to Utilize Human Subjects in Research

After a review of your proposed research project numbered **H13179** and titled **"Cultivating the Environmental Awareness of Third Graders through Inquiry Based Ecopedagogy: Impact on Students' Achievement and Attitudes,"** it appears that your research involves activities that do not require full approval by the Institutional Review Board according to federal guidelines.

According to the Code of Federal Regulations Title 45 Part 46, your research protocol is determined to be exempt from full review under the following exemption category(s):

B1 Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Therefore, as authorized in the Federal Policy for the Protection of Human Subjects, I am pleased to notify you that your research is exempt from IRB approval. You may proceed with the proposed research.

Please notify the IRB when you have completed the project by emailing irb@georgiasouthern.edu. Include the date of completion, the number of subjects (records) utilized and if there were any unexpected events related to the subjects during the project. (If none, state no unexpected or adverse events occurred during the conduct of the research.)

Sincerely,

Eleanor Haynes

Eleanor Haynes
Compliance Officer

APPENDIX B

LETTER OF COOPERATION

CLARKE COUNTY SCHOOL DISTRICT

BARNETT SHOALS ELEMENTARY

Jennifer R. Scott, Ed.S.
Principal

Bertha Troutman Rambeau, Ed.S.
Assistant Principal

December 7, 2012

Human Subjects - Institutional Review Board
Georgia Southern University
P.O. Box 8005
Statesboro, GA 30461

To Whom It May Concern:

Lori Jackson has requested permission to collect research data from approximately 42 third grade students at Barnett Shoals Elementary School through a project entitled Cultivating the Environmental Awareness of Third Graders Through Inquiry Based Ecopedagogy and Technology: Impact on Students' Achievement and Attitudes. I have been informed of the purposes of the study and the nature of the research procedures. I have also been given an opportunity to ask questions of the researcher.

The data requested including disability and program status data can be provided to the researcher with parental permission under Clarke County School District's Family Educational Rights and Privacy Act (FERPA) policy. The data will be collected by the researcher with student names for research purposes only.

As a representative of Barnett Shoals Elementary School, I am authorized to grant permission to have the researcher use participants from our school. Lori Jackson is also permitted to collect research data during school hours at Barnett Shoals Elementary School. The researcher has agreed to the following restrictions: *of securing data and sharing results of the study with parents, faculty, and staff at Barnett Shoals Elementary School and Clarke County School District.*

If you have any questions, please contact me at (706) 357-5334 ext. 35200.

Sincerely,

Jennifer R. Scott
Principal
Barnett Shoals Elementary School

Celebrating Every Student...Everyday...In Every Way
3220 Barnett Shoals Road · Athens, Georgia 30605 · (706) 357-5334 · Fax (706) 208-8835

APPENDIX C

CLARKE COUNTY STUDY APPROVAL LETTER

Feb
21

Thompson, Lora <thompsol@clarke.k12.ga.us>
to me

Ms. Jackson

On behalf of Dr. Noris Price, please be advised that your revised research proposal entitled "Cultivating the Environmental Awareness of Third Graders through Inquiry Based Ecopedagogy: Impact on Students' Achievement and Attitudes" has been approved by the Clarke County School District.

Your IRB approval letter is already on file, therefore you may contact Mrs. Jennifer Scott, Principal, to negotiate a starting date.

Thank you.

--

Lora Thompson

Executive Administrative Assistant
Deputy Superintendent's Office
(Phone) 706.546.7721 ext. 18257
(Fax) 706.549.0555
Instructional Services supports teaching and learning through collaboration, service, and leadership

APPENDIX D

CHILD LETTER FOR THE EXPERIMENTAL GROUP

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM, FOUNDATION, AND READING

MINOR'S ASSENT

Hello,

I am Lori Jackson, a graduate student at Georgia Southern University and I am conducting a study on Cultivating the Environmental Awareness of Third Graders Through Inquiry Based Ecopedagogy and Technology: Impact on Students' Achievement and Attitudes.

You are being asked to participate in a project about pollution, recycling, and conservation. During the unit, you will research and make a public service announcement about environmental concerns. You will be asked to answer a 10-question survey regarding your feelings about the environment along with taking the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit before and after the unit. You may also be selected to participate in an interview about their attitudes about the environment and technology.

You do not have to do this project. You can stop whenever you want. If you do not want to make a public service announcement, it is ok, and you can go to another classroom, and nothing bad will happen. You can refuse to do the project even if your parents have you can.

None of the teachers or other people at your school will see the answers to the questions that I ask you. All of the answers that you give me will be kept in a locked cabinet at my house and Ms. Jackson will only see your answers. Mrs. Nobles, Mrs. Dean, and Mr. Connell will watch and grade your public service announcement using the Environmental Action Rubric. We are not going to put your name on the answers that you give us, so no one will be able to know which answers were yours.

If you or your parents/guardians have any questions about this project, please call me at (706)357-5334 ext. 35357 or my advisor, Dr. Gregory Chamblee, at (912)681-5701.
Thank you!

If you understand the information above and want to do the project, please sign your name on the line below:

Yes, I will participate in this project: ___________________________________

Child's Name: ____

Investigator's Signature: ____ Date: _______________

APPENDIX E

PARENT LETTER FOR THE EXPERIMENTAL GROUP

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM, FOUNDATION, AND READING

INFORMED CONSENT LETTER

Dear Parents:
I am a graduate student at Georgia Southern University conducting dissertation research entitled Cultivating the Environmental Awareness of Third Graders through Inquiry Based Ecopedagogy: Impact on Students' Achievement and Attitudes. The purpose of this project is to involve students in more meaningful scientific inquiry based learning through the use of technology while following the third grade science standards.

If you give permission, your child will have the opportunity to participate in a three week inquiry based learning experience where they will develop a public service announcement about pollution, recycling and conservation. Your child will take the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit and the New Ecological Paradigm Scale for Children (revised) before and after the instructional period along with having three teachers grade their public service announcement about pollution, recycling and conservation using Environmental Action Rubric. Your child will also be interview about their attitudes about the environment and technology. Their participation in this study is completely voluntary. The risks from participating in this study are no more than would be encountered in everyday life; however, your child may stop participating at any time without penalty.

In order to protect your confidentiality, your child's name will not appear on any reports or used in any presentation or publications resulting from this study. The pre-test and post test from the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit and the New Ecological Paradigm Scale for Children (revised), and Environmental Action Rubric along with the audio files and transcriptions from the science journal entries and interview questions will be stored on my personal computer and placed in a locked filing cabinet in my home. Everything will be deleted upon completion of my dissertation. If you have any questions or concerns regarding this study at any time, please feel free to contact me, Lori Jackson, 239 Elderberry Circle, Athens, GA 30605, (706)543-2117 or (706)357-5334 ext. 35357, jacksonl@clarke.k12.ga.us,or my faculty advisor, Dr. Gregory Chamblee, Department of Teaching and Learning, Georgia Southern University, P.O. Box 8134, Statesboro, GA 30460, (912)681-5701, gchamblee@georgiasouthern.edu. For questions concerning the process of the Institutional Review Board in reviewing all projects involving human subjects, contact the Office of Research Services and Sponsored Programs at Georgia Southern University, 912-478-0843, irb@georgiasouthern.edu the tracking number for this study is H13179.

Thank you in advance for your help in studying this question. The results of this study should be helpful to elementary school teachers, curriculum directors, and college professors as they plan scientific inquiry at the elementary level. You will be given a copy of this consent form to keep for your records.

Sincerely,

Lori L. Jackson, Ed.D. Candidate
Georgia Southern University

______________________________________ _____________________
Parent Signature Date

I, the undersigned, verify that the above informed consent procedure has been followed.

______________________________________ _____________________
Investigator Signature Date

APPENDIX F

CHILD LETTER FOR THE CONTROL GROUP

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM, FOUNDATION, AND READING

MINOR'S ASSENT

Hello,

I am Lori Jackson, a graduate student at Georgia Southern University and I am conducting a study on Cultivating the Environmental Awareness of Third Graders Through Inquiry Based Ecopedagogy and Technology: Impact on Students' Achievement and Attitudes.

You are being asked to participate in a project about pollution, recycling, and conservation. You will be asked to answer a 10-question survey regarding your feelings about the environment along with taking the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit before and after the unit. You may also be selected to participate in an in-depth interview.

You do not have to do this project. You can stop whenever you want. You can refuse to do the project even if your parents have you can.

None of the teachers or other people at your school will see the answers to the questions that I ask you. All of the answers that you give me will be kept in a locked cabinet at my house and Ms. Jackson will only see your answers. I am not going to put your name on the answers that you give me, so no one will be able to know which answers were yours.

If you or your parents/guardians have any questions about this project, please call me at (706)357-5334 ext. 35357 or my advisor, Dr. Gregory Chamblee, at (912)681-5701.
Thank you!

If you understand the information above and want to do the project, please sign your name on the line below:

Yes, I will participate in this project: ________________________________

Child's Name: ____

Investigator's Signature: ____ Date: ______________

APPENDIX G

PARENT LETTER FOR CONTROL GROUP

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM, FOUNDATION, AND READING

INFORMED CONSENT LETTER

Dear Parents:
I am a graduate student at Georgia Southern University conducting dissertation research entitled Cultivating the Environmental Awareness of Third Graders through Inquiry Based Ecopedagogy: Impact on Students' Achievement and Attitudes. The purpose of this project is to involve students in more meaningful scientific inquiry based learning through the use of technology while following the third grade science standards.

If you give permission, your child will have the opportunity to participate in a three week science instructional unit on pollution, recycling and conservation. Your child will take the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit and the New Ecological Paradigm Scale for Children (revised) before and after the instructional period. Your child will also be interview about their attitudes about the environment and technology. Their participation in this study is completely voluntary. The risks from participating in this study are no more than would be encountered in everyday life; however, your child may stop participating at any time without penalty.

In order to protect your confidentiality, your child's name will not appear on any reports or used in any presentation or publications resulting from this study. The pre-test and post test from the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit and the New Ecological Paradigm Scale for Children (revised), along with the audio files and transcriptions from the science journal entries and interview questions will be stored on my personal computer and placed in a locked filing cabinet in my home. Everything will be deleted upon completion of my dissertation. If you have any questions or concerns regarding this study at any time, please feel free to contact me, Lori Jackson, 239 Elderberry Circle, Athens, GA 30605, (706)543-2117 or (706)357-5334 ext. 35357, jacksonl@clarke.k12.ga.us,or my faculty advisor, Dr. Gregory Chamblee, Department of Teaching and Learning, Georgia Southern University, P.O. Box 8134, Statesboro, GA 30460, (912)681-5701, gchamblee@georgiasouthern.edu. For questions concerning the process of the Institutional Review Board in reviewing all projects involving human subjects, contact the Office of Research Services and Sponsored Programs at Georgia Southern University, 912-478-0843, irb@georgiasouthern.edu the tracking number for this study is H13179.

Thank you in advance for your help in studying this question. The results of this study should be helpful to elementary school teachers, curriculum directors, and college professors as they plan scientific inquiry at the elementary level. You will be given a copy of this consent form to keep for your records.

Sincerely,

Lori L. Jackson, Ed.D. Candidate
Georgia Southern University

_______________________________________ _____________________
Parent Signature Date

I, the undersigned, verify that the above informed consent procedure has been followed.

_______________________________________ _____________________
Investigator Signature Date

APPENDIX H

PERMISSION SLIP FOR STUDY

CLARKE COUNTY SCHOOL DISTRICT

PHOTO/VIDEO CONSENT FORM FOR
RESEARCH STUDIES CONDUCTED IN THE SCHOOL DISTRICT
Please print.

I voluntarily grant to _____Lori Jackson___ (researcher/individual) permission to photograph or videotape my child while conducting research or student teaching in the Clarke County School District. Photographs or videotapes will be used for research, teaching, or professional-learning purposes only. The title of the study is __Cultivating the Environmental Awareness of Third Graders Through Inquiry Based Ecopedagogy and Technology: Impact on Students' Achievement, Attitudes, and Perceptions. Effective dates will be from February 28, 2013_ to April 28, 2013__.

Child's name: ________________________________
Address: ________________________________
____
____

School: ________________________________

I certify that I am a custodial parent/guardian and have the right to grant permission for my child to be photographed or videotaped.

Parent's or guardian's signature: ________________________________

Telephone number: ________________________________

Address: ________________________________
____
____

Today's date: ________________________________

COPIES OF THIS SIGNED CONSENT FORM MUST BE SENT TO THE CHILD'S SCHOOL (FOR STUDENT FILES) AND TO THE GRANTS AND RESEARCH OFFICE BEFORE THE RESEARCH PROJECT OR STUDENT TEACHING MAY BEGIN.

APPENDIX I

POLLUTION AND CONSERVATION TEST

Name ______________________

Date ______________________

Chapter Assessment

Pollution and Conservation

Vocabulary

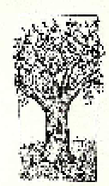
Match each term in Column B with its meaning in Column A.

	Column A	Column B
___	**1.** harmful material in the environment	**A.** nonrenewable resources
___	**2.** to use less of a resource	**B.** natural resources
___	**3.** saving resources by using them wisely	**C.** reuse
___	**4.** resources that can be replaced during a human lifetime	**D.** pollution
___	**5.** materials found in nature that are used by living things	**E.** conservation
___	**6.** to use something again and again	**F.** renewable resources
___	**7.** resources that cannot be replaced in a human lifetime	**G.** recycle
___	**8.** to break down a product and use its material again	**H.** reduce

Science Concepts

Write the letter of the best choice.

___ **9.** Look at the picture. What type of resource is the object shown in the picture?



A. reusable resource

B. renewable resource

C. refundable resource

D. nonrenewable resource

Chapter 8 • Unit C (page 1 of 4) Assessment Guide **AG 71**

Name ______________________

___ **10.** What is one way to cut down on pollution?

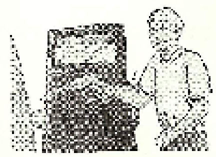
A. drive cars

B. walk to school

C. dump oil in the ocean

D. throw trash on the street

___ **11.** Look at the picture. What type of resource is the man using? Is it renewable or nonrenewable?



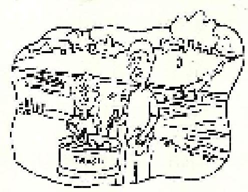
A. animal; renewable

B. gas; nonrenewable

C. trees; renewable

D. metal; nonrenewable

___ **12.** Look at the picture. Why are the father and daughter doing what they are doing?



A. because litter is harmful

B. because litter is helpful

C. because litter can be sold

D. because litter looks nice

___ **13.** Which of the following is an example of conservation?

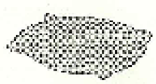
A. planting trees

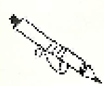
B. building more roads

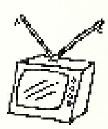
C. using lots of water

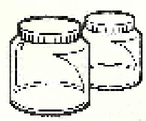
D. driving a big car

___ **14.** Look at the pictures. Which material can be recycled MOST easily?

A. 

C. 

B. 

D. 

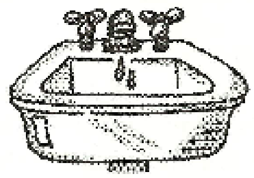
Name ______________________________

___ **15.** Which is a type of runoff that may pollute water?

A. farm chemicals
B. drinking water
C. plastic bags
D. newspapers

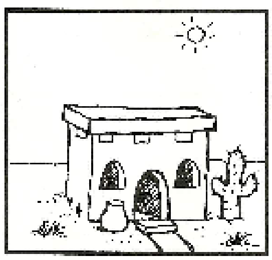
___ **16.** Look at the picture. How would you conserve this resource that is being wasted?

A. Stop washing.
B. Use cold water.
C. Fix it to stop the leak.
D. Water the lawn each day.



Inquiry Skills

17. Compare the two pictures. In which place would you **infer** that people need to conserve water? Why?



____

____

____

____

Name ______________________

18. Describe the **sequence** in which a soda bottle is made, recycled, and used again.

____

____

____

Critical Thinking

19. Why is it important to protect renewable resources, such as air and water? Why is it important to reduce our use of nonrenewable resources, such as oil and coal?

____

____

____

____

The Big Idea

20. Sandy learned that water is a reusable resource. She was told that water used to wash dishes or clothes can be reused. The thought of reusing that water did not seem like a good idea to her. What makes it possible to reuse this water? Explain your answer.

____

____

____

APPENDIX J

NEW ECOLOGICAL PARADIGM SCALE FOR CHILDREN

New Ecological Paradigm Scale for Children (revised)

Name:_______________________________

Directions: Circle your best answer to the statement

1.Plants and animals have as much right as people to live.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
2. There are too many (or almost too many) people on earth.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
3. People are clever enough to keep from ruining earth.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
4.People must obey the laws of nature.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
5.When people mess with nature it has bad results.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
6.Nature is strong enough to handle the bad effects of our modern lifestyles.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
7. People are supposed to rule over the rest of nature.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
8. People are treating nature badly.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
9. People will someday know enough about how nature works to be able to control it.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
10. If things don’t change, we will have a big disaster in the environment soon.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

APPENDIX K

ENVIRONMENTAL ACTION RUBRIC-REVISED

Names: ___________________________ Topic: __________________

Directions: Use the standards to guide the planning and creation Public Service Announcement.

S3L2. Students will recognize the effects of pollution and humans on the environment.

a. Explain the effects of pollution (such as littering) to the habitats of plants and animals.

b. Identify ways to protect the environment.

• Conservation of resources • Recycling of materials

	Exceeds the Standards (3 points) *If you consistently do all or almost all of the following.*	**Meets the Standards** (2 points) *If you consistently do most of the following.*	**Progressing Toward the Standards** (1 point) *If you consistently do some of the following.*	**Total Scores**
Content: Knows the Environmental Science Standards Must include the following vocabulary: **Pollution**- land pollution, water pollution, and air pollution. **Recycling-** recycle, reduce, and reuse. **Conservation-** renewable resource, nonrenewable resources, and natural resource.	**Exceeds** Covers all three vocabulary words about the topic and gives examples. Subject knowledge exceeds the standards.	**Meets** Covers two vocabulary words about the topic and give examples. Subject knowledge meets the standard.	**Progressing** Covers one of the vocabulary words about the topic with some examples but there are some errors. Subject knowledge is progressing toward the standards.	/3
Organization: Information organized in a way that easily to understand	**Exceeds** Content is well organized and is easy to understand.	**Meets** Most of the content is organized and can understand the topic most of the time.	**Progressing** Some of the content is organized and can understand the topic some of the time.	/3
Presentation of the video: Overall quality of interest and information presented	**Exceeds** Interesting, well-rehearsed with a delivery that holds the attention of the audience all of the time.	**Meets** Fairly well rehearsed and usually holds the attention of the audience most of the time.	**Progressing** Some rehearsal and holds the attention of the audience some of the time.	/3
				/9

Scoring:
Exceeds Standards = Total 9-8
Meets Standards= Total 7-6
Progressing Toward the Standards= Total 5-3

APPENDIX L

ENVIRONMENTAL ACTION PERFORMANCE TASK

Names:______________________________________

OVERVIEW:

This unit will demonstrate how habitats and life forms are affected by pollution along with identifying reasoning for conserving resources and recycling materials.

Focus Standards:

S3L2. Students will recognize the effects of pollution and humans on the environment.

a. Explain the effects of pollution (such as littering) to the habitats of plants and animals.

b. Identify ways to protect the environment.

- Conservation of resources
- Recycling of materials

Enduring Understanding:

Students will understand that there are harmful effects of pollution and identify various ways to protect the environment from pollution by conserving and recycling materials.

Essential Questions:

What essential questions will be considered?

1. How and Why do humans affect the environment?
2. Describe some of things we can do to help the environment?
3. Why do people harm the land?
4. Describe the different types of pollution.
5. Why should people conserve materials?
6. What type of item can you recycle, reuse, and reduce?

Performance Task

Purpose: The purpose of this activity is for students to create a public service announcement with video technology to inform others about the different environmental concerns of pollution, recycling materials, and conserving our resources.

Materials:
Poster board
Markers
Science Journal
Index cards
I-pad
Netbooks (computers)
Performance Task sheet
Rubric

Time Allotted for Task:
Two weeks for 45 minutes a day

Student grouping for task;
Students will be divided into three groups with approximately 6-7 students.

Overview summary of activity:
Create a public service announcement that persuades people to take action to stop your type of environmental concern. Make sure you include the problem, ways to help fight your issue, and why the ways should help.
Options:

1. Pollution- include the following vocabulary words: air pollution, land pollution, and water pollution
2. Recycling- include the following vocabulary words: recycling, reduce, and reuse
3. Conservation-Include the following vocabulary words: natural resources, renewable resources, nonrenewable resources, and conservation

Directions:

1. Research your topic. We can use the following resources for your research: internet, science book pgs. 310-347, and/or library books. If you have a source to help with the project feel free to use them.
2. Share your research and organize your information with your group. Decide what objectives need to be completed the next day.
3. Decide how you are going to present your information for your public service announcement.
4. Repeat steps 1-3 until you have gathered all your information and are ready to record your public service announcement.
5. Record the information on the I-pad.
6. Edit your presentation with your group

APPENDIX M

TIMELINE FOR EXPERIMENTAL AND CONTROL GROUPS

Activity Timeline for the Experimental Group:	Activity Timeline for the Control Group:
Day 1: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** 1. The class divided into three heterogeneous groups. 2. Groups of students broke down the standards and identify important vocabulary words. 3. The class then discussed the meaning of a public service announcement and how they are used to educate the public about social problems or issues. **Work Time:** Each group selected one of the following topics: recycling of materials, effects of pollution on habitats, or the conservation of resources **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	**Day 1:** **Standard:** S3L2a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What are some natural resources? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** The students broke down the scientific concepts from the Georgia Performance Standards and the key vocabulary words for the lesson. **Work Time:** 1. Students read lesson 1 pgs. 310-319 with a partner. 2. Students wrote down the facts about the environment from the textbook in their science journals. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 2: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit.	**Day 2:** **Standard:** S3L2a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What are some natural resources? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the experiment “Mining

Mini-Lesson: 1. The groups brainstormed the meaning of their topic and made a list of items that would like to research. 2. All groups received and reviewed the Environment Action Performance Task and Rubric. **Work Time:** 1. Students researched their topic using our school's laptops and wrote down any interesting facts they found in their science journals. (Students are given a science journal for this study.) 2. The students shared information on a website that they feel might be beneficial to their group or another group. 3. At the end of each day, groups discussed their progress and the focus for the next day. The teachers walked around the room and guided the students through a time reflection of the day's research and remind them to determine how they are going to present the information in a public service announcement. The teacher also facilitated conversation to make sure that each group has researched the vocabulary words for their topics. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	Resources" pgs. 312-313. **Work Time:** 1. Students did the experiment "Mining Resources" pgs. 312-313. 2. Students wrote the chart for the experiment in their science journals and wrote a conclusion about what they learned. (Students are given a science journal for this study.) **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 3: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** All groups reviewed the Environment Action Performance Task and Rubric. **Work Time:** 1. Students researched their topic using our school's laptops and wrote down any	**Day 3:** **Standard:** S3L2 b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What are some natural resources? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the directions for science workbook pgs. 154-161. **Work Time:** Students completed science workbook pgs. 154-161. **Higher Order Questions:** 1. How and Why do humans affect the environment?

interesting facts they found in their science journals. 2. Students shared information on a website that they feel might be beneficial to their group or another group. 3. At the end of each day, groups discussed their progress and the focus for the next day. The teacher walked around the classroom and guided the students through a time reflection of the day's research and reminded them to determine how they are going to present the information in a public service announcement. The teacher also facilitated conversation to make sure that each group has researched the vocabulary words for their topics. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 4: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** All groups reviewed the Environment Action Performance Task and Rubric. **Work Time:** 1. Students researched their topic using our school's laptops and wrote down any interesting facts they found in their science journals. 2. Students shared information on a website that they feel might be beneficial to their group or another group. 3. At the end of each day, groups discuss their progress and the focus for the next day. The teachers walked around the classroom and guided the students through a time reflection of the day's research and remind	**Day 4:** **Standard:** S3L2a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** The students broke down the scientific concepts from the Georgia Performance Standards and the key vocabulary words for the lesson. **Work Time:** 1. Student read lesson 2 pgs. 322-331 with a partner. 2. Students wrote down the facts about the environment from the textbook in their science journals. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and

them to determine how they are going to present the information in a public service announcement. The teacher also facilitated conversation to make sure that each group has researched the vocabulary words for their topics. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups share what they learned with the class.	reduce? **Closing:** Groups shared what they learned with the class.
Day 5: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** 1. Teacher introduced writing scripts and talked about different responsible for group members so that everyone would be involved in the process. 2. Brainstormed the process of writing a script for a public service announcement and discuss why it was important to include environmental vocabulary words. 3. Students are reminded to include content vocabulary and class reviewed the Environmental Action Rubric. **Work Time:** 1.The groups worked on writing their scripts which included vocabulary words for their topics. 2. Each group was given index cards, poster boards, and/or any type of material they might need for their presentations. Teacher provided support and guidance to students if necessary. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution.	**Day 5:** **Standard:** S3L2a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the experiment "Pollution and Plants" pgs. 324-325. **Work Time:** 1. Student set up and completed the experiment "Pollution and Plants" pgs. 324-325. 2. Students wrote the chart for the experiment in their science journals and predicted what was going to happen to the plants when salty water and oily water is added daily. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.

5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	
Day 6: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** 1. Reviewed the process of writing a script of the public service announcement and discussed why it was important to include environmental vocabulary words. 2. Discussed the materials they need for your presentation. **Work Time:** 1. Students discussed and decided how they are going to present their information in their public service announcement. 2. Groups received given index cards, poster boards, and/or any type of material they might need for their presentations. 3. The groups wrote their scripts which must include vocabulary words for their topics. Teacher provided support and guidance to students if necessary. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	**Day 6:** **Standard:** S3L2 b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How can resources be used wisely? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the experiment "Taking a Look at Trash" pgs. 338-339. **Work Time:** 1. Students set up the experiment "Taking a Look at Trash" pgs. 338-339. **2.** Students wrote the chart for experiment three in their science journals and predicted what was going to happen by collecting the trash. 3. Students wrote their observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 7: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials	**Day 7:** **Standard:** S3L2a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit.

Essential Question: What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** a. Reviewed the process of writing a script of the public service announcement and discussed why it was important to include environmental vocabulary words. b. Discussed the materials you might need for your presentation. c. Discussed the goals for today's work time to complete the project. **Work Time:** 1. The groups practiced their parts and decided on the locations for each scene. 2. Groups received given index cards, poster boards, and/or any type of material they might need for their presentations. Teacher provided support and guidance to students if necessary. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	**Mini-Lesson:** Reviewed the directions for the science workbook pgs. 162-169. **Work Time:** 1. Students completed science workbook pgs. 162-169. 2. Students wrote their observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 8: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Discussed the goals for today's work time to complete the project. **Work Time:** 1. The groups practiced their parts and decided on the locations for each scene. 2. Discussed the materials you might need for your presentation. Teacher provided support and guidance to students if necessary. **Higher Order Questions:** 1. How and Why do humans affect the environment?	**Day 8:** **Standard:** S3L2 b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How can resources be used wisely? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** The students broke down the scientific concepts from the Georgia Performance Standards and the key vocabulary words for the lesson. **Work Time:** 1. Student read lesson 3 pgs. 336-345 with a partner. 2. Students wrote down the facts about the environment from the textbook in their science journals. 3. Students wrote their observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about

2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	what was happening to the plants when salty water and oily water was added daily. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 9: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** All groups reviewed the process of videotaping using the I-movie program on the I-pad. Teacher provided support and guidance to students if necessary. **Work Time:** Students videotaped their public service announcement using the I-movie program on the I-pad. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	**Day 9:** **Standard:** S3L2 b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How can resources be used wisely? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the directions for the science workbook pgs. 170-179. **Work Time:** 1. Students completed science workbook pgs. 170-179. 2. Students wrote their final observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 10: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have	**Day 10:** **Standard:** S3L2 b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How can resources be used wisely? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit.

on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** All groups reviewed the process of videotaping using the I-movie program on the I-pad. **Work Time:** Students videotaped their public service announcement using the I-movie program on the I-pad. Teacher provided support and guidance to students if necessary. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	**Mini-Lesson:** Reviewed the directions for the experiment "Taking a Look at Trash" pgs. 338-339. **Work Time:** 1. Students put all their trash in a pile. Students separated the trash from the recyclable items. The trash is weighed and recyclable items go in the bin. **2.** Students wrote what happened when they collected the trash. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class
Day 11: (Field Trip) **Standard: Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the behavior expectations on a field trip. **Work Time:** Field Trip to Water Treatment Plant and Athens Recycling Center **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what learned at the recycling center and water treatment plant share what they learned with the class.	**Day 11: (Field Trip)** **Standard: Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the behavior expectations on a field trip. **Work Time:** Field Trip to Water Treatment Plant and Athens Recycling Center **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what learned at the recycling center and water treatment plant share what they learned with the class.
Day 12: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment.	**Day 12:** **Standard: Standard:** S3L2. Students will recognize the effects of pollution and humans on

a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definition from the unit . **Mini-Lesson:** 1. Groups reviewed the Environment Action Performance Task and Rubric. 2. Groups discussed the progress of editing public service announcement. **Work Time:** Students edited their public service announcement using the Environment Action Performance Task and Rubric. Teacher provided support and guidance to students if necessary. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the directions for Chapter 7 Review pgs. 306-307. **Work Time:** Students completed the Chapter 7 Review pgs. 306-307. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 13: **Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** What affects do people have on the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** All groups reviewed the Environment Action Performance Task and Rubric. **Work Time:** 1. Students watched and rated all the public service announcements using the Environment Action Performance Task and Rubric. 2. The groups used the Environment Action Performance Task and Rubric to guide the discussions about their scored and what they are learned. **Higher Order Questions:** 1. How and Why do humans affect the environment?	**Day 13:** **Standard: Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the rules for the Environment Jeopardy game. **Work Time:** Students played Environment Jeopardy to review environmental concepts. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution.

2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.	5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class.
Day 14: **Standard: Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the directions for the Pollution and Conservation Unit Test and the directions for the New Ecological Paradigm Scale for Children (revised). **Work Time:** 1. Students took the Pollution and Conservation Unit Test and New Ecological Paradigm Scale for Children (revised). 2. When they finished the unit test and survey, the students wrote in the science journal what they learned about pollution, conservation, and recycling from this unit. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class in a learning log in the science journal.	**Day 14:** **Standard: Standard:** S3L2. Students will recognize the effects of pollution and humans on the environment. a. Explain the effects of pollution (such as littering) to the habitats of plants and animals. b. Identify ways to protect the environment. • Conservation of resources • Recycling of materials **Essential Question:** How do people affect the environment? **Opening:** Reviewed the environmental vocabulary words and their definitions from the unit. **Mini-Lesson:** Reviewed the directions for the Pollution and Conservation Unit Test and the directions of the New Ecological Paradigm Scale for Children (revised). **Work Time:** 1. Students took the Pollution and Conservation Unit Test and New Ecological Paradigm Scale for Children (revised). 2. When they finished the unit test and survey, the students wrote in the science journal what they learned about pollution, conservation, and recycling from this unit. **Higher Order Questions:** 1. How and Why do humans affect the environment? 2. Describe some of things we can do to help the environment? 3. Why do people harm the land? 4. Describe the different types of pollution. 5. Why should people conserve materials? 6. What type of item can you recycle, reuse, and reduce? **Closing:** Groups shared what they learned with the class in a learning log in the science journal.

APPENDIX N

NARRATIVE TIMELINE FOR THE EXPERIMENTAL AND CONTROL GROUPS

Narrative Activity Timeline for the Experimental Group:

Day 1- The class was divided into three heterogeneous groups. The groups of students broke down the standards and identify important vocabulary words and their definitions for the unit. The class then discussed the meaning of a public service announcement and how they are used to educate the public about social problems or issues. Each group selected one of the following topics: recycling of materials, effects of pollution on habitats, or the conservation of resources. The lesson's closing gave students the opportunity to share what they had learned about their topic with the class.

Day 2- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. The groups brainstormed the meaning of their topic and made a list of items that they would like to research. All groups received and reviewed the Environment Action Performance Task and Rubric-Revised. The students also received science journals for the study. The science journals were used to write down information from researching their topics and reflection. Students researched their topic using our school's netbooks and wrote down facts they found interesting in their science journals. The students shared information about a website that they felt might be beneficial to their group or another group. At the end of each day, groups discussed their progress and the focus for the next day. The teacher walked around the classroom and guided the groups through a time of reflection about the day's research and reminded them to determine how they were going to present the information in a public service announcement. During the time of reflection, the group discussed their research and how it could be used along with what it meant. The teacher also facilitated conversations to make sure that each group had researched the vocabulary words for their topics. For the closing of the lesson, groups shared what they had learned with the class.

Day 3 and 4- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. All groups reviewed the Environment Action Performance Task and Rubric-Revised. Students researched their topic using our school's netbooks and wrote down facts they found interesting in their science journals. The students share information about a website that they felt might be beneficial to their group or another group. At the end of each day, groups discussed their progress and the focus for the next day. The teacher walked around the room and guided each group through a time of reflection about the day's research. During the time of reflection, the group discussed their research and how it could be used along with what it meant. For the closing of the lesson, groups shared what they had learned with the class.

Day 5- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions. Teacher introduced writing scripts and talks about different responsible for group members so that everyone would be involved in the process. In their groups, students brainstormed scripts writing, discussed their next step, and decided how they were going to present their information in their public service announcement. Students are reminded to include content vocabulary and class reviews Environmental Action Rubric-Revised. The groups worked on writing their scripts which included vocabulary words for their topics. Each group was given index cards, poster boards, and/or any type of material they might need for their presentations. Teacher provided support and guidance to students if necessary. For the closing of the lesson, groups shared what they had learned with the class.

Day 6 and 7- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. The groups worked on writing their scripts which included vocabulary words for their topics. Students discussed and decided how they are going to present their information in their public service announcement. Each group was given index cards, poster boards, and/or any type of material they might need for their presentations and discussed the materials they needed for your presentation. Teacher provided support and guidance to students if necessary. For the closing of the lesson, groups shared what they had learned with the class.

Day 8- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. The groups discussed the goals for today's work time to complete the project. The groups practice their parts and decided on the locations for each scene and discuss the materials you might need for your presentation. Teacher provided support and guidance to students if necessary. For the closing of the lesson, groups shared what they had learned with the class.

Day 9 and 10- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students acted out their scripts around the school and/or campus while they videotaped their public service announcement using the I-movie program on the I-pad. Teacher provided support and guidance to students if necessary. For the closing of the lesson, groups shared what they had learned with the class.

Day 11 – Students reviewed the environmental vocabulary words and their definitions from the unit along with the behavior expectations on a field trip. Students went on a field trip to the Athens Recycling Center and Water Treatment Plant.

Day 12- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students edited their public service announcement using the Environmental Action Rubric-Revised and Environmental Action Performance Task. Teacher provided support and guidance to students if necessary. For the closing of the lesson, groups shared what they had learned with the class.

Day 13- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students watched and rated all the public service announcements using the Environmental Action Rubric-Revised and Environmental Action Performance Task. The groups use the Environment Action Rubric-Revised to guide the discussions about their scoring and what they learned. The group's video that was being watched left the room so the other groups could talk freely about their observations. When the group returns, the other groups discuss their observations. This process continues until all group video have been rated and discussed. For the closing of the lesson, groups shared what they learned with the class.

Day 14- For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students took the New Ecological Paradigm

Scale for Children and the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit Test. All students that had problems reading the test and survey were read to them as part of the accommodations. Students wrote in their journals what they learned during the pollution, conservation, and recycling unit. For the closing of the lesson, groups shared what they learned during the unit with the class.

Narrative Activity Timeline for the Control Group:

Day 1: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. The students and teacher broke down the scientific concepts from the Georgia Performance Standards and the key vocabulary words for the lesson. Students read lesson 1 pgs. 310-319 with a partner. Students wrote down the facts about the environment from the textbook in their science journals. The students also received science journals for the study. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 2: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for the experiment "Mining Resources" pgs. 312-313. Students did the experiment "Mining Resources" pgs. 312-313. Students wrote the chart for the experiment in their science journals and wrote a conclusion about what they learned in the science journal for this study. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 3: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for science workbook pgs. 154-161. Students completed science workbook pgs. 154-161.Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 4: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. The students and teacher broke down the scientific concepts from the Georgia Performance Standards and the key vocabulary words for the lesson. Student read lesson 2 pgs. 322-331 with a partner. Students wrote down the facts about the environment from the textbook in their science journals. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 5: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for the experiment "Pollution and Plants" pgs. 324-325. Student set up the experiment "Pollution and Plants" pgs. 324-325. Students wrote the chart for the experiment in their science journals and predicted what was going to happen to the plants when salty water and oily water is added daily. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 6: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for the experiment "Taking a Look at Trash" pgs. 338-339. Students set up the experiment "Taking a Look at Trash" pgs. 338-339. Students wrote the chart for experiment three in their science journals and predicted what was going to happen by collecting the trash daily for a week. Students wrote their observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 7: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for the science workbook pgs. 162-169. Students completed science workbook pgs. 162-169. Students wrote their observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. Teacher walked around the room to help students. Students continued to collect their own trash for a week for the experiment "Taking a Look at Trash" pgs. 338-339. For the closing of the lesson, groups shared what they had learned with the class.

Day 8: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. The students broke down the scientific concepts from the Georgia Performance Standards and the key vocabulary words for the lesson. Student read lesson 3 pgs. 336-345 with a partner. Students wrote down the facts about the environment from the textbook in their science journals. Students wrote their observations for the experiment "Pollution and Plants" pgs. 324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. Teacher walked around the room to help students. Students continued to collect their own trash for a week for the experiment "Taking a Look at Trash" pgs. 338-339. For the closing of the lesson, groups shared what they had learned with the class.

Day 9: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for the science workbook pgs. 170-179. Students completed science workbook pgs. 170-179. Students wrote their final observations for the experiment "Pollution and Plants" pgs.

324-325 in their science journals about what was happening to the plants when salty water and oily water was added daily. Teacher walked around the room to help students. Students continued to collect their own trash for a week for the experiment “Taking a Look at Trash” pgs. 338-339. For the closing of the lesson, groups shared what they had learned with the class.

Day 10: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for the experiment “Taking a Look at Trash” pgs. 338-339.Students put all their trash in a pile. Students separated the trash from the recyclable items. The trash was weighed and recyclable items went in the bin. Students wrote what happened when they collected the trash. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 11: Students reviewed the environmental vocabulary words and their definitions from the unit along with the behavior expectations on a field trip. Students went on a field trip to the Athens Recycling Center and Water Treatment Plant.

Day 12: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the directions for Chapter 7 Review pgs. 306-307. Students completed the Chapter 7 Review pgs. 306-307. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 13: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students and teacher reviewed the rules for the Environment Jeopardy game. Students played Environment Jeopardy to review environmental concepts. Teacher walked around the room to help students. For the closing of the lesson, groups shared what they had learned with the class.

Day 14: For opening of the lesson, the students reviewed the environmental vocabulary words and their definitions from the unit. Students took the New Ecological Paradigm Scale for Children and the Georgia Third grade Harcourt School Publishers Science's Pollution and Conservation Unit Test. All students that had problems reading the test and survey were read to them as part of the accommodations. Students wrote in their journals what they learned during the pollution, conservation, and recycling unit. For the closing of the lesson, groups shared what they learned during the unit with the class.