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The Effects of Technology Education on Science Achievement

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THE EFFECTS OF TECHNOLOGY EDUCATION
ON SCIENCE ACHIEVEMENT

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SIGNATURE PAGE

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CHAPTER I
INTRODUCTION

The educational field is constantly looking for innovative ways to instruct topics to students more efficiently. Recently, there has been a focus on science, mathematics, and technology education because of the United States current mathematics and science achievement levels compared to other nations. One of the studies, the PISA (Program for International Student Assessment, 2003), ranked the United States behind 25 other nations in regards to mathematics and science skills. Although the United States are making improvements in mathematics and science due to the No Child Left Behind Act, work still needs to be done to improve the ranking of the United States with its biggest economic competitors, such as Korea, Hong Kong, and Japan (Washington, 2006). There are other studies, programs, and bills being designed on how to improve the United States mathematics, science, and technology education.

The ways teachers instruct is not the only thing that is changing. Technology is varying the way we do things at home, school, and work. Since technology is such a huge part of our daily lives and is changing rapidly, it is no surprise that it should also be included in classrooms to help prepare students for the technological world of the future. A movement that is taking place to ensure the United States success is STEM-integrating instruction in science, technology education, engineering, and mathematics. "Concepts in science, technology education, and mathematics show powerful relationships when it comes to student learning" (Berry et al., 2005, p. 23). For that reason, researchers have been investigating the impact of integrating different subjects on student learning and achievement.

Statement of the Problem

The problem of this study was to determine the effect of technology education units of instruction on science achievement of third grade students.

Hypothesis

To solve this problem, the following hypotheses were tested:

H_1: Within a third grade classroom, technology education units of instruction will affect students' achievement on the Science Tests For Higher Standards more than non-participants in such instruction.

H_2: Within a third grade classroom, technology education units of instruction will affect students' achievement on the Science Standards of Learning more than non-participants in such instruction.

Background and Significance

The United States is in a similar situation it was about 40 years ago when President Eisenhower mandated a national program to improve mathematics and science education, following the launch of Sputnik (Kamiercak & James, 2005). Today, there continues to be a growing concern in the United States on the need to improve science, mathematics, and technology education so that the U.S. can compete in the global economy successfully in the 21st century (Washington, 2006). Protecting America's Competitive Edge (PACE) Act was introduced in 2006 and listed 20 recommendations to improve mathematics, science, and technology education. The PACE Act hearing held in

Washington in 2006 stated that according to the TIMSS study fourth grade students in the United States did not improve their standings in mathematics achievement and actually declined in science achievement. In order to lead in economic and technological advancements in the world, the United States needs to invest in improving science, mathematics, and technology education.

As stated earlier, to guarantee the United States's success in the future there is now a focus on STEM education, which was created to strengthen K-12 instruction in science, technology education, engineering, and mathematics. "STEM provides a forum for Congress and the science, education and business communities to discuss challenges, problems, and solutions related to STEM education" (http://www.stemedcaucus.org/Default.aspx). This is one of the beginning steps to promote a change in education to solve this achievement gap with other nations.

Since our world is rapidly changing, the educational system needs to adapt so that students can be equipped to handle potential jobs and tasks of the future.

> It can be said that the practice of teaching science has been more traditional than any other curriculum area, but technological developments have affected science education also. There are some issues and problems in science education. The technological developments could help science teachers to overcome these problems (Isman et al., 2007, p. 54).

In order to do this, technology education needs to be included in science educational programs beginning at pre-school to help solve some of these problems in science education and to gather research on this topic. According to Stables (1997), children who are given more support to find out how things work, to make things work, and to create and to express themselves, the better chance there is for their technological capability to prosper. Therefore, students must be given opportunities to investigate throughout their schooling and technology education programs to ensure those types of learning experiences can occur.

It is important for educators to focus on science, mathematics, and technology education. According to Furner and Kumar (2007), integrating mathematics and science in the schools has become a central issue by such organizations as School Science and Mathematics Association (SSMA), the National Council of Teachers of Mathematics (NCTM), the American Association for the Advancement of Science (AAAS), and the National Research Council (NRC). All of these organizations believe there is a need for integrating mathematics and science education, which shows the need for researching these areas. Preparing students to have stronger skills in these subjects will ensure that they will be equipped for future jobs in those areas. This will give the United States a better chance to create innovations and compete in the economic market.

The following study was done to determine if introducing technology education concepts at third grade would improve science achievement on the Tests for Higher Standards and the SOL's. The results of this study would promote the need for technology education in elementary schools in the United States. Providing students with the foundations of technology education in elementary school will prepare students for achievement in middle and high school science and technology education programs. Currently the United States has technology being integrated during the school day in elementary education, but it is not a required core class such as language arts, mathematics, social studies, or science.

Limitations

In this study, the following limitations must be considered:

1. The results of this investigation were confined to third grade students at Tanners Creek Elementary School in Norfolk, Virginia.
2. This research does not examine the different instructional strategies used to teach these students the technology education standards.
3. The researcher was not able to observe or document any additional assistance given to students outside of the classroom to help them prepare for the Virginia SOL tests or Norfolk Public Schools Tests for Higher Standards.
4. This research was administered in an urban school where 51% of students received free lunch and 13% received reduced price lunch (U.S. University Directory, 2008).

Assumptions

In this study, the following factors were believed to be true for all students and teachers involved:

1. All students in the control group received the same instruction.
2. The students ranged from below, on, to above grade level standards.
3. The teacher taught each of the indicated technological literacy standards.
4. The teacher used technology activities to teach the science content.

Procedures

Students received instruction on technology education over a 10-week period, based on the International Technology Education Association's (ITEA) *Standards for Technological Literacy*, which were developed in April 2000. The standards were a list of what students should know and be able to do to be technological literacy. These standards were a guideline for all schools to help promote technological literacy, but it was not a curriculum. The science and technology activities were designed around the alignment of the *Standards for Technological Literacy* and the Science Third Grade Curriculum.

Then, the Virginia Third Quarter Science Tests for Higher Standards and the Science Standards of Learning scores of the third grade students that participated in the technology education program were collected and compared to the students' scores that did not receive the technology education units of instruction. The scores were compared to determine if there was a significant variation in those that received the technology education instruction and those that did not.

Definition of Terms

During this study, certain terms were used that needed to be defined so that there was a clear understanding of the ideas or concepts.

1. **Technology Education-** Technology Education is a class in school that teaches how to use, manage, assess, and understand technology. The purpose of this class would be to produce technological literate students.

2. **Technological Literacy**- "Technological literacy is the ability to use, manage, assess, and understand technology" (ITEA, 2000).
3. **SOL**- Standards of Learning Assessments are given to students in Virginia to evaluate students learning.
4. **Tests for Higher Standards (TFHS)**- the quarterly assessment given to students in Norfolk, Virginia, in Reading, Writing, Mathematics, Science, and Social Studies to help prepare them for the SOL's.
5. **STEM-** integrating instruction in science, technology education, engineering, and mathematics.
6. **STL-** Standards of Technological Literacy established by the International Technology Association to identify what every child needs to know and must be able to do to become technologically literate.

Overview of Chapters

Chapter I explained the reasons why researching technology education and science achievement in education is a growing concern for the United States. The problem of the study was stated, which was to determine the effect of technology education units of instruction on science achievement of third grade students. The goal of this study was to determine within a third grade classroom, that technology education units of instruction will affect students' achievement on the Science Tests For Higher Standards and the Science Standards of Learning more than non-participants in such instruction. Some of the programs and legislation being set up by the United States government such as STEM and the PACE Act were discussed to help show the significance of this study along with what researchers have found out about this topic. Also, the limitations and assumption of the study were listed to specify how this investigation would be conducted and the amount of control the researcher had during the investigation. To complete this study, the units of technology education instruction would last for 10-weeks and would compare the TFHS and SOL scores of the participants receiving the units of instruction to the students that did not participate in the program. Finally, Chapter I included a list of important terms, so that individuals would have a clear understanding of these concepts used in this study.

Chapter II will review other research on integrating technology education into elementary education and the affects of science achievement. Chapter III will explain the methods and procedure used to conduct this investigation. Chapter IV discusses the results of the study. Chapter V lists the conclusions from this study and recommendations for future research.

CHAPTER II

REVIEW OF LITERATURE

Technology education has been a focus of organizations, research, and legislation for many years due to the urgent need for improving technology education (Bybee, 2003). Project 2061, the International Technology Education Association (ITEA), No Child Left Behind (NCLB) Act, STEM Education, and Protecting America's Competitive Edge (PACE) Act have all stated concerns for science, mathematics, and technology education in the United States. This review will cover technology education in the United States, science education in the United States, and integrating technology education in the elementary schools.

In today's society, students need to develop technological literacy in order to be qualified for future careers. "Technology education is the only subject area specifically designed to deliver technological literacy" (Meade & Dugger, 2004, p. 32). The United States has focused on integrating technology education into classrooms for a number of years. Unfortunately, "research conducted so far on the effectiveness of technology in the classroom reports mixed findings" (Reksten, 2000, p. 2). Therefore, there is still much to learn about technology education and integrating it into different school subjects. This review will confirm the need for this study and the need to implement technology education into the elementary schools to improve science achievement.

Technology Education

Over the past 30 years the United States has realized the need for improvement in the areas of science, mathematics, and technology education. The focus on improving science and mathematics has influenced the development and importance of technology education in the United States.

In 1988, the International Association for Evaluation of Educational Achievement (ITEA) reported that out of 17 countries tested for science achievement, the United States ranked in eighth for 10-year-olds and the results were worse in the secondary schools. As a result of this report, Project 2061 was published in 1989 and focused mainly on improving science education (Childress & LaPorte, 1997). The project recommended that science, mathematics, and technology be integrated as much as possible and that benchmarks, or the understanding and skills students should have to become literate in a certain subject, were to be established for science, mathematics, and technology education. After Project 2061, the National Science Teachers Association and the National Council of Teachers of Mathematics developed new standards for science and mathematics. Both of these reforms realized the importance of including technology education (Childress & LaPorte, 1997).

The International Technology Education Association (ITEA) is a large professional organization that was formed to enhance technology education in our schools. They developed the Technology for All Americans Project in 1994 to promote the study of technology and technological literacy for all of society (ITEA, 2000). This project resulted in developing the *Standards for Technological Literacy (STL): Content for the Study of Technology* through funding from the National Science Foundation and NASA in 2000. The *Standards for Technological Literacy* were developed by an assortment of groups of educators, engineers, technologists, teams, committees, and others appointed by ITEA (ITEA, 2000). These standards identified what every child needed to know and must be able to do to become technologically literate. They are not a curriculum, but a guide to what the outcomes of the study of technology should be in grades K-12 (ITEA, 2000).

In January 2002, President Bush signed the No Child Left Behind (NCLB) Act, which focused on improving America's public schools. The NCLB Act requires that each state "create strong standards for what every child should know and learn in reading and math in grades 3-8. Student progress and achievement will be measured for every child, every year. The Act also focuses educational dollars on proven, research-based approaches that will most help children to learn" (http://www.whitehouse.gov/news/releases/2002/01/20020108.html). This holds every state accountable for educating every child and makes sure that states are using funding on programs that have been proven to work. Standardized tests are used to hold each state accountable and measure students' knowledge and understanding of specific subjects. The NCLB Act has led many states to set up a "core set of subject areas for all students as a way to meet national educational standards" (Meade & Dugger, 2004, p. 29). Technology education is not mentioned as a subject area in the NCLB Act, but it does require technology literacy for all students. Although, the NCLB Act does not describe what technology/technological literacy means it does appear that the NCLB Act views technology/technological literacy as defined in the STL (Meade & Dugger, 2004).

Meade and Dugger (2004) reported the following data based on the International Technology Education Association's Technology for All Americans Project that conducted a survey in 2004 on the current state of technology education. It found that 38 states (78.1%) included technology in the state framework, 12 states (23.1%) required technology education, 22 states (42.3%) offered technology education as an elective, and 41 states (78.8%) are using STL. They also found that there was an overall decrease in the amount of technology education teachers across the United States. They concluded that the only way to guarantee that all students will become technologically literate is to require technology education as a core subject and making it a requirement for graduation.

A movement called STEM or Science, Technology, Engineering and Mathematics Education is trying to improve how science, mathematics, and technology education are taught in schools. STEM focuses on preparing students for the workforce and the needs of our industries that are constantly changing over time. STEM gives Congress and the science, education, and business communities a chance to discuss challenges, problems, and solutions related to STEM education (http://www.stemedcaucus.org/Default.aspx). They focus on the importance of integrating science, technology education, engineering, and mathematics. According to the STEM Initiatives (2004), programs should include building on knowledge from each level in education, provide hands-on, open-ended, real-world problem solving experiences, and promote hands-on activities and research orientated classes for effective teaching in science, technology education, engineering, and mathematics.

These programs have all contributed to improving technology education in the United States and have played a part in acknowledging the role technology education has on developing highly qualified individuals for the workplace. Remember that technology education is still not required in all 50 states and some states do not use the Standards of

Technological Literacy (STL) at all. Therefore, technology education still has a long way to go if the United States intends to create students that will be technologically literate.

Science Education

The programs listed above all mentioned the need for improving science as well as mathematics and technology education. It also suggested that science and mathematics are closely intertwined with each other and with technology. Programs have been set up to improve science instruction because science inquiry and scientific literacy is needed for almost everyone. People are needed to use scientific information to make choices and more and more jobs are requiring people to be able to learn, reason, think creatively, make decisions, and solve problems (Roblyer, 2000).

The National Science Education Standards Project was established in 1995 to reform science instruction. The standards stated that ALL students should be able to attain higher levels of scientific inquiry than they already do, learn science in the content standards, and develop knowledge and understanding of science concepts according to the standards. The project also stated that learning science is an active process, more time, personnel, and materials must be devoted to science education, and that improving science is part of systemic education reform (Roblyer, 2000). These standards focused on science as an inquiry approach; meaning that students should make observations, ask questions, research what is known, conduct experiments, propose answers, and present results. The standards are not a curriculum, so each state is left to figure out how the curriculum should be organized (Roblyer, 2000).

In 2006, Protecting America's Competitive Edge (PACE) Act was presented to further improve math and science outcomes for the future and aid in the NCLB Act's goals (Washington, 2006). The Act established programs to provide additional highly qualified science and mathematics teachers in elementary and secondary schools and offer more Advanced Placement programs in America's high schools.

The projects described above are some of the ways the United States has been attempting to improve science instruction. Another area that has been of great interest is integrating subjects such as science, mathematics, and technology education to improve the knowledge and understanding of certain topics.

> Science and mathematics are relatively easy to integrate, and there are examples of success at all levels. Science has often used technology examples to illustrate the application of laws and principles. However, the activities in which the students are engaged usually intended to allow them to "discover" what is already known (Childress & LaPorte, 1997, p. 71).

Technology integration could be the missing link to making science come alive for students and making the material relevant to their interests and experiences. Researchers have spent a lot of time investigating the integration of science and technology education.

"Activities can be used to increase students' understanding of knowledge in science, technology education, and mathematics" (Berry et al, 2005, p. 28). There have been a number of activities set up for teachers to help integrate science, mathematics, and technology education, such as the Technology, Science, Mathematics Integration Project and Mission 21 (Childress & LaPorte, 1997). Both of those projects helped teachers by developing curriculum activities for the elementary and middle schools.

One of the views of learning today is that people construct new knowledge and understanding based on what they already know or their prior knowledge. This is known as constructivism and also referred to as contextual learning. Constructivist teachers believe that students should be actively engaged for learning to occur effectively. Using this philosophy for science instruction, teachers should use the following five strategies: relating, experiencing, applying, cooperating, and transferring. "The Center for Occupational Research and Development (CORD) identified these five strategies (REACT) as contextual learning strategies because they help teachers put teaching and learning into context" (Berry et al, 2005, p. 25). By aligning the curriculum in science and technology, teachers are able to create units or applying activities that "attempt to build and strengthen student skills in those subjects that can lead to scientific and technological career pursuits" (Berry et al, 2005, p. 24). These unit activities for science and technology education should use the five REACT strategies on hands-on projects.

The United States has taken different measures to improve science instruction that range from creating standards to instructional integration activities. Research still needs to be conducted to find out what programs are successfully producing students that possess scientific literacy. Also, researchers continue to investigate different ways to integrate science, mathematics, and technology education and how it will improve students' knowledge and understanding of different concepts.

Elementary Schools

Children are said to develop 50 percent of their mature intelligence by the time they are 4 and another 20 percent by the time they are 8 (Foster & Kirkwood, 1997). According to this information on intellectual development, elementary schools have a very important role on educating children. That is why many studies that focus on improving science, mathematics, and technology education have explored elementary, middle, and high school students' performance in those subjects.

Some of the issues of integrating science, mathematics, and technology education at the elementary school level are that teachers are poorly prepared to teach these subjects, instruction relies on teaching from the textbook, and science and technology are sometimes excluded due to time restraints (Childress & LaPorte, 1997). The use of textbooks seems to be less effective, so elementary school teachers are integrating reading and science (Childress & LaPorte, 1997). Many science, mathematics, and technology concepts can be found in children's novels and can help motivate students to learn more. To improve elementary school science and technology education, teachers should be provided with training and there needs to be equipment, supplies, facilities, and funding for all of the following to be accomplished (Childress & LaPorte, 1997).

The rationale for curriculum integration in elementary schools is for subject matter relevance and to improve student achievement. It is very important for students to understand why they are learning something and how it relates to their life. This can help motivate children to learn. Curriculum integration is also an effective way to include various subjects in an overcrowded elementary school curriculum (Childress & LaPorte, 1997).

"Many studies in elementary school curriculum integration do not show significant student achievement based on their treatments. Nonetheless, such studies are informative" (Childress & LaPorte, 1997, p. 82). Kulik collected more than 500 individual research studies of computer-based instruction in 1994. Two of the studies were on the elementary school level and showed gains of 16% (Bangert-Drowns, 1985) and 14% (Niemiec & Walbert, 1985) over the control group (Schacter, 1999). Brusic compared the science achievement and scientific curiosity of fifth grade students that received science instruction integrated with technology education. The results found that there were no significant differences between groups in science achievement, but there was a difference in curiosity in the treatment group (Childress & LaPorte, 1997). Sivin-Kachala reviewed 219 research studies from 1990 to 1997 to assess the effect of technology on learning and achievement on all aged learners. The study concluded that students in technology environments experienced positive effects on achievement in all subject areas, increased achievement in preschool and higher education for both regular and special needs children, and student's attitudes towards learning improved. The study also found that the effectiveness of educational technology was influenced by the student population, the software used, the educator's role, and students' access to the technology (Schacter, 1999).

In *Critical Issues to Consider When Introducing Technology Education into the Curriculum of Young Learners*, Stables (1997) mentions that the more children are given the opportunity to explore and engage in technological activities the better chance they have to become technologically capable. Stables (1997) also suggests that students must learn through experience and by being active learners. Students should be given the opportunity to learn through hands-on exploration, especially in the area of problem solving. Teachers also need to be properly prepared and trained to teach technology education in the elementary schools. Instructors must remember that students need to be actively involved in the learning process throughout technology education, while the teacher is the facilitator.

There are different approaches to integrating science, mathematics, and technology education in elementary schools. Research still needs to be done to figure out the most effective strategies for integrating these subjects.

Summary

In today's schools, science and technology education have an important role in education. Elementary schools have a number of concepts and skills to teach students for each grade level. In order to fit everything in and develop students' skills and understanding effectively, teachers are integrating subjects. Further research needs to be conducted in elementary schools to discover if integrating science and technology education will offer a deeper understanding of the concepts and improve student achievement. This research is needed to determine if units of technology education will effect science achievement on the Third Quarter Science Tests for Higher Standards and the Science SOL's of third grade students in Norfolk, Virginia.

Chapter III will explain the methods and procedures used to conduct this study. The population and instructional techniques used to integrate units of technology education during science instruction will be explained in more detail in the next chapter. The chapter will also discuss how the data were analyzed.

CHAPTER III

METHODS AND PROCEDURES

This chapter contains the methods and procedures used to gather information that was needed to conduct this investigation. The research study was experimental in nature. This chapter describes in greater detail the population that was studied, the research variables from the hypothesis, and the instruments used for this study. The classroom procedures are explained, along with the description of the data collection methods and the statistical analysis. A summary will conclude this chapter.

Population

The population included two groups of third grade students at Tanners Creek Elementary School in Norfolk, Virginia. Tanners Creek Elementary School is an urban school district and the third grade students are Asian (4%), African American (67%), Hispanic (2%), American Indian (1%), Multi Racial (11%), and White (13%). One group received the technology education units of instruction for 10 weeks (Group 1). Group 1 included twenty-one students, in which 19% were special education students and 81% were regular education students. The other group received the normal third grade curriculum and did not include technology education units of instruction (Group 2). Group 2 included seventy-seven students, in which 8% were special education students, 14% were gifted, and 79% were regular education students.

Research Variables

The research variables that were included in this study are the students receiving technology instruction as the independent variable and the test scores as the dependent variable. The students in Group 1 received technology education units of instruction based on the International Technology Education Association's *Standards for Technological Literacy (STL).* Group 2 students followed the normal third grade curriculum at Tanners Creek Elementary School and did not receive technology education units of instruction.

Other extraneous variables that could impact the results of this study were time restrictions, limited resources, and lack of funding. The amount of time given to teach each technology lesson may or may not have impacted the results of this study. Also, the lack of materials, tools, and funding needed to provide a deeper explanation of the concepts and skills from the STL, so students could explore through hands on activities, may or may not have affected the results of the study.

Instrument Design

The Virginia Third Quarter Science Tests For Higher Standards and the Virginia Science Standards of Learning assessments were both used to gather information on students for this study. Stuart Flanagan and David E. W. Mott designed the Science Test For Higher Standards (TFHS). The test consisted of 49 multiple-choice questions and covered all of the science concepts and skills from the first, second, and third quarters in the third grade curriculum. The highest score a student could receive on the test was an 100. The Science Test for Higher Standards assessment was given three weeks after the technology education units of instruction began.

The Science Virginia Standards of Learning assessment is also a multiple-choice question test. This assessment was given after the 10 weeks of technology education units of instruction were completed and included questions based on the kindergarten, first, second, and third grade science curriculum. The highest score a student could receive on the assessment was 600.

Both of the assessments were paper and pencil-based tests. Students needed to bubble in their answers on a machined scored answer sheet. The Tests For Higher Standards answer sheets were collected and run through the D2SC scanning device, which calculated each child's score and provided a report of all the scores. The Standards of Learning assessments were collected and mailed to the Virginia Department of Education. They graded each answer sheet and sent the school the results.

Classroom Procedures

The technology education units of instruction were provided to Group 1 students through hands on projects, PowerPoint presentations, discussions, cooperative learning activities, and literature. The technology lessons were designed around the *Standards for Technological Literacy (STL)* and were integrated with science concepts taught in the third grade from the Virginia Standards of Learning. Group 2 students did not receive units of instruction in technology education.

There were 20 *Standards for Technological Literacy* that specified what every student should know and be able to do in order to be technologically literate (ITEA, 2000). There were benchmarks that followed each standard at every grade level to describe the knowledge and abilities that will help students to meet the specific standard. There were five major topics for *Standards for Technological Literacy* and they were: Nature of Technology (Standards 1-3), Technology and Society (Standards 4-7), Design (Standards 8-10), Abilities For A Technological World (Standards 11-13), and The Design World (Standards 14-20). The *3-5 STL Standards and Benchmarks*, Table 1, will describe the *Standards for Technological Literacy* taught, the lessons, and instructional activities that went along with the units.

Table 1. ***STL*** **Standards and Benchmarks/Lessons**	
<u>Standard 1</u>. Students will develop an understanding of the characteristics and scope of technology. ***In order to comprehend the scope of technology, students should learn that:*** C. Things that are found in nature differ from things that are human-made in how they are produced and used. D. Tools, materials, and skills are used to make things and carry out tasks. E. Creative thinking and economic and cultural influences shape technological development.	***3 days-30 minute lessons*** *Integrated with Science SOL 3.10(Resources)* **<u>Lesson-</u>** Students were shown a PowerPoint that described each of the benchmarks for this standard. Students picked out things from nature and human made objects, discussed the tools, materials, and skills needed to make things and carried out tasks, and discussed what influences the development of technology. **<u>Activities-</u>** 1-Students had to sort pictures into things from nature and human-made objects. They also had to list what was needed to produce objects from nature and human-made objects. 2-Students had to list the tools, skills, and materials needed to complete specific jobs, along with the job they would like to have in the future.
<u>Standard 2</u>. Students will develop an understanding of the core concepts of technology. ***In order to comprehend the core concepts of technology, students should learn that:*** F. A subsystem is a system that operates as a part of another system. G. When parts of a system are missing, it may not work as planned. H. Resources are the things needed to get a job done, such as tools and machines, materials, information, energy, people, capital, and time. I. Tools are used to design, make, use, and assess technology. J. Materials have many different properties. K. Tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing. L. Requirements are the limits to designing or making a product or system.	***4 days-30 minute lessons*** *Integrated with Science SOL 3.10(Resources) and 3.3Matter* **<u>Lessons-</u>** 1-Students were shown a PowerPoint describing tools and machines. Students identified the resources needed to get a job done. Students also sorted resources for different tasks and explained the energy needed for different resources. **<u>Activities-</u>** 1-Draw a machine or tool from home or school, describe how it helps humans, and explain the energy needed to power the tool or machine. 2-Students were given different materials and they had to describe it (properties) and list what it might be used for.

<u>Standard 3.</u> Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. ***In order to appreciate the relationships among technologies and other fields of study, students should learn that:*** B. Technologies are often combined. C. Various relationships exist between technology and other fields of study.	***1 day-30 minutes*** *Integrated with Science SOL 3.2 (simple machines)* **<u>Lesson & Activity</u>**-Review simple machines and discuss some tools and machines that combine simple machines to make new technologies, such as an escalator.
<u>Standard 4</u>. Students will develop an understanding of the cultural, social, economic, and political effects of technology. ***In order to recognize the changes in society caused by the use of technology, students should learn that:*** B. When using technology, results can be good or bad. C. The use of technology can have unintended consequences.	***2 day-30 minutes*** *Integrated with Science SOL 3.10 & 3.11 (resources)* **<u>Lesson-</u>** Students watched a video on safety and discussed how technology can be helpful and can also be harmful. **<u>Activity</u>**-Students wrote a paragraph about some type of technology and how it was helpful and/or harmful.
<u>Standard 5</u>. Students will develop an understanding of the effects of technology on the environment. ***In order to discern the effects of technology on the environment, students should learn that:*** B. Waste must be appropriately recycled or disposed of to prevent unnecessary harm to the environment. C. The use of technology affects the environment in good and bad ways.	***3 days –20-30 minute lessons*** *Integrated with Science SOL 3.10 (Conservation)* **<u>Lesson-</u>** 1-Read a magazine article from KidsDiscover about recycling. Discuss how some products are good and/or bad for the environment. 2-Students were shown the video Taking Care of Our Earth from unitedstreaming.com **<u>Activity-</u>** 1-Go outside and pick up trash. Sort the materials into groups (recyclable or landfill) 2-Look up some information on the computer about different technology. Make a list of at least one piece of technology and how it effects the environment (good/bad).
<u>Standard 6</u>. Students will develop an understanding of the role of society in the development and use of technology. ***In order to realize the impact of society on technology, students should learn that:*** B. Because people's needs and wants change, new technologies are developed, and old ones are improved to meet those changes. C. Individual, family, community, and economic concerns may expand or limit the development of technologies.	***5 days- 20 minute lessons*** *Integrated with SOL 3.6 (comprehension of nonfiction) & 3.2 (Simple Machines)* **<u>Lesson</u>**-Read the story <u>Transportation: Yesterday and Today</u>. Discussion on why transportation changed over time? Discussed other inventions that have changed because of people's needs and wants. Watched a video from *unitedstreaming* called Away We Go: All About Transportation.

	<u>Activity-</u>Discussed transportation of the future and had students create a transportation device of the future.
<u>Standard 7</u>. Students will develop an understanding of the influence of technology on history. ***In order to be aware of the history of technology, students should learn that:*** B. People have made tools to provide food, to make clothing, and to protect themselves.	***2 days-20-30 minutes*** *Integrated with Science SOL 3.4 (Life Processes)* **<u>Lesson</u>**-Discussed the resources needed to provide food, make clothing, and to protect themselves. **<u>Activity</u>**-Students searched through magazines, newspapers, and the computer to find different tools. They created a collage of the items by putting the pictures they found onto three different class posters that were labeled: tools for food, clothes, or for protection.
<u>Standard 8</u>. Students will develop an understanding of the attributes of design. ***In order to realize the attributes of design, students should learn that:*** C. The design process is a purposeful method of planning practical solutions to problems. D. Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design.	***1 day 30 minutes*** *Integrated with Science SOL 3.10 (Natural events)* **<u>Lesson</u>-** Discuss how builders need a plan before they start making a house. Explain why it is important to come up with a design or plan first. **<u>Activity</u>-** Students had to create a house that could survive a flood. They needed to come up with a drawing and explain the materials they would use. Students then had to share their ideas with their groups. Next, they critiqued each other's ideas by picking out the strengths and weaknesses of the design. Finally, each group decided on what they liked from each house and then picked or created their final design.
<u>Standard 10</u>. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. ***In order to comprehend other problem-solving approaches, students should learn that:*** C. Troubleshooting is a way of finding out why something does not work so that it can be fixed. D. Invention and innovation are creative ways to turn ideas into real things. E. The process of experimentation, which is common in science, can also be used to solve technological problems.	***5 days-30 minute lessons*** *Integrated with Science SOL 3.1 (scientific method)* **<u>Lesson & Activity</u>**- 1-Students were given different pieces of technology that were not working. They needed to try and fix the problem by listing different ways they tried to fix the problem. A discussion followed this activity explaining that they were troubleshooting. 2-A PowerPoint helped explain that inventions and innovations are creative ways to turn ideas into real things. Students started to think

	about what they might invent. 3-Students were given a technological problem and they had to experiment to try and solve the problem.
<u>Standard 12</u>. **Students will develop the abilities to use and maintain technological products and systems.** ***As part of learning how to use and maintain technological products and systems, students should learn that:*** D. Follow step-by-step directions to assemble a product. E. Select and safely use tools, products, and systems for specific tasks. F. Use computers to access and organize information. G. Use common symbols, such as numbers and words, to communicate key ideas.	***5 days-30 minute lessons*** *Integrated with Science SOL 3.2 (simple machines)* **<u>Lessons & Activities</u>**- 1-Students were given directions and had to put together a toy car. Students discussed if there were any problems and if they needed to add any steps to the directions. 2-Students had to describe to a partner how to use a tool, product, or system correctly and if there was any safety rules to follow. 3-Students needed to use the computer to find out information on simple machines. They also needed to use Kidspiration to create a graphic organizer containing the information they discovered.
<u>Standard 16</u>. **Students will develop an understanding of and be able to select and use energy and power technologies.** ***In order to select, use, and understand energy and power technologies, students should learn that:*** C. Energy comes in different forms. D. Tools, machines, products, and systems use energy in order to do work.	***2 days-30 minute lessons*** *Integrated with Science SOL 3.11 (Energy)* **<u>Lesson & Activity</u>**-The students had to come up with different forms of energy. They were given different tools, machines, products, and systems and needed to explain what type of energy was needed to make it work. They also watched a video on energy.
Standard 17. Students will develop an understanding of and be able to select and use information and communication technologies. ***In order to select, use, and understand information and communication technologies, students should learn that:*** D. The processing of information through the use of technology can be used to help humans make decisions and solve problems. E. Information can be acquired and sent through a variety of technological sources, including print and electronic media. F. Communication technology is the transfer of messages among people and/or machines over distances through the use of technology. G. Letters, characters, icons, and signs are symbols that represent ideas, quantities, elements, and operations.	*5* ***days-30 minute lessons*** *Integrated with Science SOL* 3.7 *(soil) and SOL 3.9 (water cycle)* **<u>Lesson</u>-** Discuss communication and communication technology. Described advertising as a communication activity: sender, message, and audience. **<u>Activity</u>-** Develop an advertisement for conserving water or soil.
<u>Standard 18</u>. **Students will develop an understanding of and be able to select and use transportation technologies.** ***In order to select, use, and understand transportation technologies,***	***1 days- 20 minute lessons*** *Integrated with SOL 3.6 (comprehension of nonfiction) & 3.2 (Simple Machines)*

students should learn that: D. The use of transportation allows people and goods to be moved from place to place. E. A transportation system may lose efficiency or fail if one part is missing or malfunctioning or if a subsystem is not working.	**Lesson**-Read the story Transportation: Yesterday and Today and watched a video on transportation. Students came up with examples of how people and goods are moved from place to place. **Activity-** Students found goods on the internet that are transported from California. They had to figure out a route to get to Virginia using maps and come up with some problems that may occur when the goods are being transported.

Methods of Data Collection

The data for this research study were collected through Tanners Creek Elementary School for the Third Quarter Science Tests For Higher Standards. The Virginia Board of Education scored the Science Standards of Learning assessment and sent the scores back to Tanners Creek Elementary School. After receiving all of the data for Group 1 and Group 2 on the Science TFHS and the Science SOL exams, their scores were organized in a table to analyze.

Statistical Analysis

The data gathered from the Third Quarter Science TFHS and the Science SOL from Group 1 and Group 2 were analyzed to determine if the hypothesis was true. The mean of Group 1 and Group 2 on the TFHS and the SOL exam was calculated. T-tests were performed on both assessments to determine if there was a significant difference in the scores between Group 1 that received the units of technology education instruction and Group 2 who did not receive the units of technology education.

Summary

Chapter III described the methods and procedures used to conduct this study. The topics covered in this chapter were population, research variables, instrument design, classroom procedures, methods of data collection, and statistical analysis. The results of the study's research will be presented in Chapter IV, Findings.

CHAPTER IV

FINDINGS

The problem of this study was to determine the effect of technology education units of instruction on science achievement of third grade students at Tanners Creek Elementary School. The Third Quarter Science Tests For Higher Standards and the Virginia Science Standards of Learning (SOL) assessments were given to students and the data were collected. This chapter contains the results of the data collected. The data were used to determine if there was a significant difference in the Third Quarter Science Tests For Higher Standards and the Virginia Science SOL Assessment scores of third grade students that received the technology education units of instruction, with third grade students who did not receive the units of technology education.

Report of Findings

The experimental group, Group 1, contained twenty-one third grade students from one third grade classroom who received technology education units of instruction for 10 weeks. The control group, Group 2, consisted of seventy-seven third grade students from four third grade classrooms who did not receive technology education units of instruction during the school year. There were a total of ninety-eight students used in this research.

T-tests were used to determine if there was a significant difference in the Third Quarter Science Tests For Higher Standards scores of third grade students that received the technology education units of instruction, with third grade students who did not receive the units of technology education. T-tests were also used to determine if there was a significant difference in the Virginia Science SOL Assessment scores of third grade students that received the technology education units of instruction, with third grade students who did not receive the units of technology education. The data for the t-tests are shown in Tables 2-3. The Third Quarter Science Tests For Higher Standards and the Science Standards of Learning scores for the experimental and control group are included in the Appendix.

Science Tests For Higher Standards

Group 1 consisted of nineteen third grade students (two students were absent for the test and did not retake it) and Group 2 consisted of seventy-seven third grade students. Group 1, the experimental group, had a mean of 68.31, and Group 2, the control group, had a mean of 60.35. A t-test was conducted and found on a one-tailed test at the $p>.05$ level of significance the t-value was 1.750 and the degree of freedom was 94. Table 2 shows the results of the t-test on the Science Tests For Higher Standards.

Table 2. t-test results for the Science Tests For Higher Standards

	Group 1	**Group 2**
Sample Size	N=19	N=77
Mean	M_1=68.31	M_2=60.35
Degree of Freedom	df=94	
t-value	t=1.750	

Virginia Science SOL

Group 1 consisted of twenty-one third grade students and Group 2 consisted of seventy-seven third grade students. Group 1, the experimental group, had a mean of

453.33 and Group 2, the control group, had a mean of 439.30. A t-test was conducted and found on a one-tailed test at the p>.05 level of significance the t-value was 0.819 and the degree of freedom was 96. Table 3 shows the results of the t-test on the Virginia Science SOL assessment.

Table 3. t-test results for the Science Virginia Standards of Learning (SOL)

	Group 1	**Group 2**
Sample Size	N=21	N=77
Mean	M_1=453.33	M_2=439.30
Degree of Freedom	df=96	
t-value	t=0.819	

Summary

This chapter included the data that was collected from the Third Quarter Science Tests For Higher Standards and the Virginia Science SOL Assessment for third grade students who received technology education units of instruction, Group 1, and the third grade students who did not receive technology education units of instruction, Group 2. t-tests were performed on the Third Quarter Science Tests For Higher Standards and the Virginia Science SOL Assessment for third grade students who received technology education units of instruction, Group 1, and the third grade students who did not receive technology education units of instruction, Group 2. This chapter collected and reported the results from the t-tests. Chapter V will give a brief description of the research study. It will also include the conclusions from the study and recommendations for future research studies.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In this chapter the study will be described in detail. Also, the results from the data will be interpreted. Finally, conclusions from the data will be made for the study and recommendations for further study in the area of technology education in the elementary schools will be presented.

SUMMARY

The problem of this study was to determine the effect of technology education units of instruction on science achievement of third grade students at Tanners Creek Elementary School in Norfolk, Virginia. The hypotheses of this study were that within a third grade classroom, technology education units of instruction will affect students' achievement on the Science Tests For Higher Standards more than non-participants in such instruction and within a third grade classroom, technology education units of instruction will affect students' achievement on the Science Standards of Learning more than non-participants in such instruction

Technology is constantly changing and is involved in every aspect of our lives. Students need to be prepared for the future with new innovations and a competitive job market. This study focused on determining if technology education units of instruction affected students' achievement in science. Conducting this study will hopefully stress the importance of including technology education in elementary schools.

In this study, the following limitations must be considered:

1. The results of this investigation were confined to third grade students at Tanners Creek Elementary School in Norfolk, Virginia.
2. This research does not examine the different instructional strategies used to teach these students the technology education standards.
3. The researcher was not able to observe or document any additional assistance given to students outside of the classroom to help them prepare for the Virginia SOL tests or Norfolk Public Schools Tests for Higher Standards.
4. This research was administered in an urban school where 51% of students received free lunch and 13% received reduced price lunch (U.S. University Directory, 2008).

In this study, the following factors were believed to be true for all students and teachers involved:

1. All students in the control group received the same instruction.
2. The students ranged from below, on, to above grade level standards.
3. The teacher taught each of the indicated technological literacy standards.
4. The teacher used technology activities to teach the science content.

The study consisted of two groups of students. Group 1, the experimental group, contained twenty-one third grade students that received the units of technology education. Group 2, the control group, contained seventy-seven third grade students from four different classrooms that did not receive the units of technology education. The units of technology education instruction lasted for 10-weeks and consisted of hands-on activities based on the *Standards of Technological Literacy* that were integrated into the Virginia

Third Grade Science curriculum. The *Standards of Technological Literacy* specified what every student should know and be able to do in order to be technologically literate.

The Virginia Third Quarter Science Tests For Higher Standards (TFHS) was given during the 10-week period, while the Virginia Science Standards of Learning (SOL) was given at the end of the 10-week period. The Virginia Third Quarter Science THFS and SOL data were organized and t-tests were performed to determine if there was a significant difference between the students in Group 1, students who received units of technology education, and Group 2, students who did not receive units of technology education.

CONCLUSIONS

To solve this problem, the following hypotheses were tested:

H_1: Within a third grade classroom, technology education units of instruction will affect students' achievement on the Science Tests For Higher Standards more than non-participants in such instruction.

The findings of this study indicated that there was a statically significant difference in the Virginia Third Quarter Science TFHS scores between students who received the units of technology instruction, Group 1, and students that did not receive units of technology instruction, Group 2, at a t-value of 1.750 and $p>.05=1.658$. Based on the results of the one-tailed t-test conducted, we must accept the hypothesis that technology education units of instruction will affect students' achievement in science on the Third Quarter Science Tests For Higher Standards more than non-participants since the t-value (1.750) was greater than the .05 level of significance (1.658).

H_2: Within a third grade classroom, technology education units of instruction will affect students' achievement on the Science Standards of Learning more than non-participants in such instruction.

The Virginia Science Standards of Learning t-test indicated that there was a statically insignificant difference in the scores between students who received the units of technology instruction, Group 1, and students that did not receive units of technology instruction, Group 2, at a t value of 0.819 and $p>.05=1.658$. Based on the results of the one-tailed t-tests conducted, we must reject the hypothesis that technology education units of instruction will affect students' achievement in science on the Science Standards of Learning more than non-participants in such instruction in a third grade classroom. Although, students that received the units of technology instruction did have a higher mean than students that did not receive the units of technology instruction. The mean was 453.33 for the students that received units of technology education, Group 1, and the mean was 439.30 for students who did not receive units of technology instruction, Group 2.

RECOMMENDATIONS

This study was preformed to determine if units of technology instruction increased science scores on the Virginia Tests For Higher Standards and the Virginia

Standards of Learning assessments. The data showed that there was a significant difference in performance on the Virginia Third Quarter Science Tests For Higher Standards between the students that received the units of technology instruction and the students that did not receive the units of technology instruction. The data for the Virginia Standards of Learning assessments showed a higher mean for the experimental group but there was not a statistically significant difference in performance between the students that received the units of technology instruction and the students that did not receive the units of technology instruction.

Based on the results and conclusions of this study, the following recommendations were made:

1. Educators should continue to support and integrate technology into their lessons based on the need for students to be technologically literate and because of the significant difference found between the two groups on the TFHS and the higher mean on the SOL assessment.
2. Further study on technology education units of instruction in the elementary school should be performed and include additional features such as problem-solving abilities and hands-on activities.
3. Further study on technology education in the elementary schools should be performed and results should be based on other types of assessments besides standardized tests such as the ability to perform a certain task or solve a problem.
4. A study on technology education units of instruction in elementary school and how it affects students' science performance in middle and high school.

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APPENDICES

Appendix A

Science Tests For Higher Standards Scores				
Group 1: Experimental	**Group 2: Control**	**Group 2: Control**	**Group 2: Control**	**Group 2: Control**
73.47	**85.71**	**89.80**	**79.59**	**87.76**
65.31	**81.63**	**89.90**	**69.39**	**85.71**
65.31	**77.55**	**87.76**	**69.39**	**85.71**
40.82	**77.55**	**85.71**	**65.31**	**81.63**
38.78	**73.47**	**79.59**	**65.31**	**79.59**
63.26	**63.27**	**77.55**	**63.27**	**75.51**
69.39	**61.22**	**77.55**	**59.18**	**73.47**
67.35	**57.14**	**75.51**	**57.14**	**73.47**
67.35	**55.10**	**75.51**	**46.94**	**69.39**
73.47	**55.10**	**75.51**	**44.90**	**69.39**
81.63	**53.06**	**75.51**	**42.86**	**69.39**
75.51	**51.02**	**69.39**	**40.82**	**65.31**
85.71	**51.02**	**69.39**	**40.82**	**63.27**
77.55	**51.02**	**59.18**	**38.78**	**63.27**
85.71	**46.94**	**57.14**	**38.78**	**59.18**
75.51	**42.86**	**57.14**	**34.69**	**55.10**
51.02	**38.78**	**53.06**	**30.61**	**38.78**
71.43	**34.69**	**38.78**	**30.61**	**30.61**
69.39	**30.61**	**36.73**	**24.49**	
	28.57	**30.61**		

Appendix B

Virginia Science SOL Assessment Scores				
Group 1: Experimental	**Group 2: Control**	**Group 2: Control**	**Group 2: Control**	**Group 2: Control**
475	348	491	306	400
370	320	427	461	491
448	377	409	539	583
437	355	418	334	511
370	409	283	539	475
448	583	511	409	427
448	427	511	539	437
437	461	427	437	491
409	418	392	409	583
418	355	409	491	491
461	475	461	461	448
511	427	409	355	400
475	384	511	491	313
600	448	427	511	400
491	392	427	437	418
461	392	475	461	437
475	392	418	600	298
392	418	355	320	583
392	348		539	437
491	491			583
511				