Comparing Attitudes Toward Technology Of Third and Fourth Grade Students In Virginia Relative To Their Exposure To Technology

By

Duane D. Dunlap

B.S. The Ohio State University

M.S. Louisiana State University

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APPROVED:

Dr. William E. Dugger, Jr.

Dr. F. Marion Asche

Dr. Michael P. Deisenroth

Dr. James E. LaPorte

Dr. Charles A. Pinder

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COMPARING ATTITUDES TOWARD TECHNOLOGY OF THIRD AND FOURTH GRADE STUDENTS IN VIRGINIA RELATIVE TO THEIR EXPOSURE TO TECHNOLOGY

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Duane D. Dunlap

William E. Dugger, Jr., Technology Education

(ABSTRACT)

The purpose of this study was to compare student attitudes toward technology of third and fourth grade students in Virginia relative to their exposure to technology education. The instrument used to measure student attitudes towards technology was a modified version of the Pupil's Attitudes Toward Technology - USA instrument developed at Virginia Polytechnic Institute and State University.

The research design was a quasi-experimental, non-equivalent groups posttest only design. The research methodology utilized was factorial analysis of variance. The four independent variables were Gender, Grade Level, Treatment/Control Group, and Geographic Area. The dependent variable was student attitudes toward technology. All hypotheses were tested at the .05 alpha level of significance.

The NASA funded project, Mission 21, was used as the treatment on 459 third and fourth graders in Virginia over

the period of five months. Students in the same schools and grade levels as Mission 21 students, but who were not exposed to Mission 21, served as the control group. The control group contained 399 students.

The study reported a significant difference between boys and girls attitudes towards technology. There was a significant difference in student attitudes toward technology between the Mission 21 students and the control group. There was no difference found in student attitudes towards technology by grade level. There was a significant difference of student attitudes towards technology between geographic areas (urban, suburban, and rural areas).

The most common definition of technology from the Mission 21 students (treatment group) was "technology solves problems". The most common definition of technology from the control group was "I don't know".

The results of the study provided evidence that both boys and girls who participated in the third and fourth grade Mission 21 project, did in fact, have a substantially more positive attitude towards technology than those students who did not.

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CHAPTER ONE

Comparing Attitudes Toward Technology Of Third and Fourth Grade Students In Virginia Relative To Their Exposure To Technology

Introduction

Technology plays an active role in the society in which we live. Postman (1989) pointed out, "technology now controls everything from our jobs to our religion to our social and family values" (p. 9). Not one day passes without any one of us coming in contact with some facet of technology. The elementary school setting is an intact place where students can experience, first hand, the role of technology in our society and begin making judgments about it. According to de Vries (1988), "...pupils do not enter technology education without any ideas about technology. By watching TV, by listening to the radio, by reading various kinds of magazines they get ideas about what technology is and what it means to them" (p. 4).

The need for integrated technology education in elementary curriculum development is critical. Technology is continually evolving and expanding. According to Dr. Paul DeVore (1980), "...life depends on technology that most people do not understand" (p. 6). During the 1984 Technology Education Symposium VI, Peterson stated, "...the place to begin to develop an understanding of the technological systems we depend upon is the elementary school" (p. 23). However, throughout many school systems in America, elementary school students do not have the opportunity to become involved in structured technology education activities.

The opportunities offered students by technology education at the elementary school level investigated by Kieft (1988) incorporate, "helping children develop and improve their problem-solving skills, personal/social growth characteristics, develop career and consumer awareness and reinforcing basic skills from other subject areas" (p. 29). Students often become inquisitive about technology, wanting answers to "how", "why", and "what if" questions. Research conducted by Peterson showed, "there is significant potential for the discovery of technology in the elementary school" (1986, p. 16).

Many national educational reports suggesting reform have led to the rethinking of curriculum in the elementary classroom. United States Representative Frederick C. Boucher remarked, "we need to develop technological skills among our youth" (1988, p. 4).

The Technology Education Advisory Council of the International Technology Education Association issued a report titled, <u>Technology: A National Imperative</u>, that provided justification for organizing educational goals for promoting technological literacy of Americans:

> Because the American culture is distinctly characterized as technological, it becomes the function of our educational system to provide every student an insight and understanding of the technological nature of the culture. All persons must be knowledgeable of their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny. As technological development continues at an accelerated rate, it will become increasingly more difficult for people to understand these changes. Extreme action must be taken to prevent us from becoming a technologically illiterate nation. (1988, p. 2).

In the report, Educating Americans for the 21st Century (1983), the National Science Foundation declared the study of technology should be considered as essential as reading and writing in the classroom. The report further mentioned where the emphasis on technology education at the elementary school should be by stating, "stress should be placed on the importance of modern technology through relevant examples and hands-on technological activities" (NSF p. 70).

Beginning in the fall of 1985, the National Aeronautics and Space Administration (NASA) joined with the Technology Education Program at Virginia Polytechnic Institute and State University (VPI&SU) with a goal to expand technology education at the elementary school level. NASA awarded a Graduate Student Researchers Program Grant to VPI&SU to develop a technology education elementary school program, initially for fifth and sixth grades, titled MISSION 21. The purpose of Mission 21 was to provide technology education materials for the elementary school curriculum. Mission 21 materials were infused through flexible problem-solving activities. Mission 21 activities, called "design briefs", were integrated with science, mathematics, social studies, language arts, health, and fine arts. Field centers were set up in the Commonwealth of Virginia to test the materials developed through the project. Since 1985, Mission 21 has involved 30 teachers and over 3,000 students in 15 schools throughout Virginia.

Mission 21 has developed into a first through sixth grade technology education project. Mission 21 is an interdisciplinary approach to teaching technology.

Statement of the Problem

The purpose of this study is to compare third and fourth grade student attitudes towards technology relative to their exposure to Mission 21 (treatment and control) in selected schools in Virginia.

Research Questions

The research questions for this study at the elementary school level (third and fourth grade) are:

1. How do boys and girls differ in their attitudes toward technology?
2. Is there a difference in the attitudes toward technology of the treatment and control group?
3. Is there a difference between third and fourth grade student attitudes toward technology?
4. Is there a difference between student attitudes toward technology in urban, suburban, and rural schools?
5. Is there an interaction among the study variables (gender, treatment, grade level, and geographic area) on attitudes toward technology?
6. How do students who have had Mission 21 (treatment group) differ in their definitions of technology from those who were in the control group?

Purpose and Significance of the Study

Evaluation of the Mission 21 project has been primarily subjective feedback from classroom teachers and Mission 21 research associates. Professors, administrators, and classroom teachers have also reviewed Mission 21 resource materials for appropriateness and accuracy. Previous efforts of integrating technology in the elementary school have not measured student attitudes before or after experiencing technology education based activities. There has been no statistical data collected up to this point because the program has been in the developmental stage. Developing curriculum materials should involve the collection and interpretation of data. By analyzing the data, decisions can be made to improve curriculum materials.

This study is significant because it was the first to compare attitudes of third and fourth grade students experiencing formal technology education instruction. The study also assessed the effectiveness of Mission 21 (treatment group) in providing students with a more positive attitude toward technology. One of the goals of this project was to help students become technologically aware of their world. The instrument was administered to a control group of third and fourth grade students. These students were at the same grade level within the same school(s). The purpose was to compare their responses with the responses of students experiencing Mission 21.

Limitations of the Study

The following limitations were identified in this study:

1. Students in the treatment groups were exposed to as few as five Mission 21 activities.
2. The sample was selected from pre-existing field test sites of the Mission 21 program.
3. Teachers were allowed to choose the themes and design briefs in which students participated.
4. This study included only third and fourth grade students.
5. The quasi-experimental, posttest only design with nonequivalent groups was used in this study.

Delimitations of the Study

1. The study was delimited to six elementary schools and 18 teachers in the Commonwealth of Virginia.
2. The use of the term "technology" in this study includes the uses of technology in society, the effects of technology on individuals and society, and the use of technological processes and products by people.

Definition of Terms

The following definitions were used for this study:

1. Mission 21 - NASA funded research project for developing technology education materials at the elementary school level.
2. Technology - "is the application of math and science for specific purposes... to make our lives better, more productive or more enjoyable" (Technology Education Advisory Council, 1988, Foreword).
3. Technology Education - "the school discipline for the study of the application of knowledge, creativity, and resources to solve problems, and extend human potential" (Technology Education Advisory Council, 1988, p. 16).
4. Technological Literacy - "A perception of how technology can impact society and the environment. The technologically literate person can distinguish between technology and science" (Croft, 1990, p.155).
5. Quasi-Experimentation - "experiments that have treatments, outcome measures, and experimental units, but do not use random sample assignment to create the comparisons from which treatment-caused change is inferred" (Cook & Campbell, 1979, p. 6).
6. Attitudes - "a mental and neutral state of readiness, organized through experience, exerting a directive or

dynamic influence upon the individual's response to all objects and situations to which it is related" (Allport, 1935, p. 14).

Summary

This study provided attitudinal and definitions of technology data from third and fourth grade students. The information gained about the preference students have in their perception of technology helps technology education professionals develop appropriate curriculum resource materials and programs.

The attitudes of elementary school students toward technology is an important topic for research. Research conducted by Raat, de Vries, and de Klerk Wolters (1989) recommend that for technology education curriculum to be complete, student attitudes toward technology must be taken into consideration. Technology plays an important role in our culture. The National Aeronautics and Space Administration provided resource reports concerned with providing experiences that increase the technological literacy of our youth.

Attitudes toward technology can range from tools, machines, and computers to perceptions, impacts on society, and the environmental concerns involved in everyday life. If technology education materials developed by the Mission

21 staff for the elementary student are to be effective, then research concerning student attitudes about technology must be conducted.

CHAPTER TWO

Review of Related Research and Literature

Introduction

This study proposed that Mission 21, integrated into the elementary school curriculum, improves student attitudes toward technology. Documented as early as 1965, elementary schools that unite technology education with the existing curriculum, "the intergrated [sic] approach has been the most common pattern in grades one through four" (Champion, p. 17). If technology education can be shown to enhance the learning of other subjects and increase student comprehension of technology in their world, a much more willing endorsement may be envisioned. Further, de Klerk Wolters (1989a) states that "education in technology can also contribute to the development of a more positive attitude towards technology" (p. 3).

In investigating educational literature involved with methods or procedures used to measure student attitudes toward technology at the elementary school level, one is concerned with the relatively small amount of research or data related to the measurement of attitudes. Little, if any attempt has been made to study third or fourth grade student attitudes toward technology.

The move to incorporate the study of technology into the existing elementary school curriculum has been a slow process. George Champion (1965) concluded, "industrial arts can be implemented in the elementary school curriculum through the integration with other subjects by providing an effective means for demonstrating the value of other subjects while stimulating an interest in learning" (p. 113). Because technology education at the elementary school has no long standing tradition, research and curriculum development are important. Research is needed to make effective curriculum decisions when developing technology education curriculum for the elementary school level. "To develop the education in technology, in such a way that it gives pupils a fairly balanced concept of technology, it is necessary to determine students' attitudes about technology" (de Klerk Wolters, 1989a, p. 3). Once this bench-mark has been established, technology education curriculum developers will have information to produce effective materials for the third and fourth grade.

The need for determining attitudes about technology from elementary school children is critical for developing technology education program materials such as Mission 21. Downs (1974), makes the case that "research should continue on developing instruments for use in measuring both student and teacher attitudes toward curricular content presented by an elementary school industrial arts approach" (p. 307).

What Is Technology?

Technology has given many people in our world a life never before experienced. Virtually all segments of human life are touched by technological growth. Some of us have become so accustomed to advanced technology in our lives that it becomes functionally invisible to us. We take it for granted until it fails, then we blame technology, unaware that it has greater reliability than previous alternative technologies. According to Johnson, Lauda, and Pytlik (1985), "Whether we view technology negatively, positively, or passively, we find ourselves making value judgements about it" (p. 291).

To determine a foundation for the term technology, it is meaningful to cite the dictionary definition. Webster's Ninth New Collegiate Dictionary (1988) defines technology as "(1): technical language, (2) a: applied science b: a scientific method of achieving a practical purpose, (3) the totality of the means employed to provide objects necessary for human sustenance and comfort" (p. 1211).

The word "technology" has assumed many meanings throughout history. In 1980, Lauda traced the usage of the word "technology" to the year 1615 and reported that a prescribed definition materialized in 1676. Lauda and McCrory (1986) explain the word technology by splitting it into two components. They are "(1) technic which refers to the principle or method in making things, and (2) logos which refers to the study of those principles or methods" (p. 21). Further, they state technology "is the study of the technical means the human has initiated and utilized for survival" (p. 21).

The use and application of technology has been documented throughout history. Bender (1988) contended that historically, "technology is the application of theoretical knowledge to specific social and economic tasks, has been supported by science, the pursuit of knowledge and the understanding of the physical and human environment" (p. 174). Bender went on to quote Hannay and McGinn, (1980) who stated, "Thus, technology, the instrumental mode of rationale action, is created by human beings to expand the realm of practical possibility" (p. 181).

Technology is not to be confused with science. In simple terms, science involves an emphasis on theory, focusing on "why", and attempts to explore and explain. Technology emphasizes practice, focuses on the "how", and attempts to evaluate and apply. A report issued in 1983 by the National Science Board (NSB) Commission on Precollege Education in Mathematics, Science, and Technology, stated:

> Alarming numbers of young Americans are ill-equipped to work in, contribute to, profit from and enjoy our increasingly technological society. Far too many

> young Americans have emerged from the nation's elementary and secondary schools with an inadequate grounding in mathematics, science, and technology...at a time when America's national security, economic well-being, and world leadership increasingly depend on mathematics, science, and technology, the nation faces serious declines in skill and understanding in these areas among all our youth. (p. 9).

Lux (1983) contrasted the difference between science and technology relative to its connection to industrial technology education. He stated that "As a school subject, science offers a systematic study of knowledge about nature, while technology is a systematic study of how people alter nature to make it of more use or value" (pp. 9-10).

Johnson, Lauda, and Pytlik (1985) point out that "Technology changes society, it provides people with new capabilities and new opportunities; it makes obsolete some ways of life and some values" (p. 9). Technological growth results in changing the world; it spotlights human beings struggling with environments of their own making. Anything enhanced or developed by technological means should be done so for mankind. Todd, McCrory, and Todd, (1985, p. 3) defined technology as "the use of our knowledge, tools, and skills to solve practical problems and to extend human capabilities".

The Virginia Technology Education Service (1988) stated that technology is the "study of the application of knowledge, creativity and resources to solve problems and extend human potential" (p. 8). The Virginia Technology Education Service document (The Virginia Technology Education Curriculum, K-12) was recognized from the review of literature to be one of the most contemporary approaches to technology education and to serve as an approach to support a definition of technology.

"Technology, like science, is boundary free and can help cement national friendships, which are sorely needed" (Hellman, 1976, p. 66). America is the heartland for developing many new technologies. However, few countries around the globe want our spiritual or ideological aspirations. But, foreign countries are very interested in our computers, weapons, airplanes, agricultural products, and industrial automation capabilities. Technology affects all raw and processed goods that people use.

Technology reaches people through the use of tools, machines, devices, and systems that help us live and work every day. According to Schrage (1990), "one of the most powerful themes driving technological development is the belief that everything can be engineered. Changing technology isn't in the technologies themselves, but in how people will approach and finally use them". Many technology educators across the country have awakened to the fact that in some form, they must keep abreast with changing technology.

John Naisbitt (1982) writes in his book Megatrends, that there are three stages of technology. These stages include "First, the new technology or innovation follows the line of least resistance; second, the technology is used to improve previous technologies (this stage can take a long time); and third, new directions or uses are discovered that grow out of the technology itself" (p. 27).

Dr. Donald Maley (1983) Professor Emeritus and former department chairman at the University of Maryland points out that "technology with respect to the development of the human component must deal with the processes of learner development in systematic inquiring, problem solving, analyzing, synthesizing, and generalizing" (p. 7).

Importance of Technological Literacy

In today's society, we live in a time of unprecedented change, a change brought about by technology. "Technological advance is a dynamic rather than a static process" (Uhlig, 1983, p. 2). Methods and learning activities created by curriculum developers in technology education must also be unremitting. A need for the growth of a technologically literate citizenry is an understanding that technology as a whole is more than computers or electronics. Technology must be comprehended as a system that extends human capability and potential. Part of being technologically literate implies having the ability to enter into complex thinking and feel comfortable in problem-solving situations. Technological problems or situations have no single right or wrong answers. Only the "best solutions based on available information to solve problems can be employed" (Ost, 1985, p. 691). Ost points out, "an important characteristic of technologic literacy is a positive attitude" (1985, p. 691).

Characteristics of being technologically literate include the ability to predict the potential impact of an innovation, understand technology systems, and possess the ability to investigate a problem and propose a solution. Shamos (1984) believed that "most students, and the public, generally, relate more easily to technology than to science because they have daily contact with products of technology" (p. 3). Technological literacy is not only regarded as a learning outcome suited for general education, but also needed in the workplace. The Northwest Regional Educational Laboratory (1984) study determined, "technological literacy is a combination of skills and attitudes--some very general and others very specific".

Waetjen (1987a), Chairman of the ITEA Technology Education Advisory Council, wrote that technological literacy implies "that a student must understand basic scientific concepts; know societal needs and moral constraints; be cognizant of the application of scientific principles to tools and materials; and, to a certain extent, be able to utilize these tools and materials" (p. 10).

Sinn and Savage (1987) contend on the other hand, that "Perhaps we will become more technologically literate by combining more courses with an increase in the length of the school day by thirty minutes as is recommended by some of the more recent education studies" (p. 27).

The National Science Board in 1983 issued a report defining technology literacy. In the report, "The technologically literate person should have a sense of what technology can or cannot do. He or she should not believe that technology can solve all ills, nor that it is responsible for most problems" (p. 74).

Buchen (1980) in his explanation on a curriculum for the year 2000, wrote:

> ...What is clearly needed is the creation of a new category of technological literacy as minimum knowledge required to be a reasonable educated or civilized human being. In fact, never before has the knowledge of machines been such an important

condition for the knowledge of being human.
(p. 394).

The term technological literacy has numerous interpretations and uses. However, Todd (1986) reports the capacity of technological literacy in a much larger framework. His taxonomy incorporates five levels of technological literacy that include "awareness, literacy, capability, creativity and criticism" (p. 63).

Business and industry spend millions of dollars each year to provide employees problem-solving skills and training to function effectively in the world of work. America's national economy is at stake. The Exxon Educational Foundation (1984) during a symposium on education decided, "there is a growing feeling that the scientific and technological dimensions of our society, government, and economy are now fully sufficiently extensive that virtually all citizens must become scientifically and technologically literate" (p. 3). It is in part because of these conditions, that research about student attitudes toward technology at the third and fourth grade level is sought.

Technology Education In America's Public School System

Historically, technology education, formerly industrial arts, has focused curriculum development at the high school and junior high/middle school educational levels in the public school system. The study of technology education (then referred to as industrial arts) at the elementary school level was first established in 1931 by Theresa Gunther. Gunther conducted the first doctoral research on elementary school industrial arts. The title of her dissertation was, The Manipulative Participation in the Study of Elementary Industrial Arts. Gunther conducted research to "compare the value of the conventional method of studying the facts from books with the manipulative participation method. It includes pupils studying industrial arts in the elementary grades. Two units of subject matter were studied in each of thirteen classes, selected from grades three to six" (Downs, 1974, p. 252).

William Warner's research on the industrial arts profession lead to the development of The Curriculum to Reflect Technology in 1947. This study generated an innovative progression for the industrial arts profession. Warner (1952) defined industrial arts as "a general and fundamental school subject in a free society concerned with providing experiences that will help persons of all ages and both sexes to profit by the technology, because all are involved as consumers, many as producers, and there are countless recreational opportunities for all" (p. 5).

Devore (1966) viewed technology as a discipline centering on man's development of his technology being directly related to his social-cultural influences. Further, Devore researched technology as a discipline for a formal education curriculum stating, "the study of man and technology (including the technical and cultural-social elements) as a creative endeavor in meeting the needs of individuals and cultures, in the area of production, transportation and communication, through the utilization of the properties of matter and energy" (p. 11).

Another significant attempt to revise the industrial arts curriculum in the 1960's was the publication of Delmar Olsen's dissertation, "Technology and Industrial Arts." Olsen (1963) contended that the focus for the study of technology should be on the uniqueness of man and man's interaction with his environment. Olsen charged that curriculum content for industrial arts should originate from the study of technology as portrayed by industry. Olsen believed that the study of technology should include the following eight basic areas: "manufacturing, construction, power, transportation, electronics, research, services, and management" (Luetkemeyer/Martin, 1979, p. 37).

The Transition from Industrial Arts to Technology Education

The change from industrial arts to technology education evolved "due to the tremendous amount of curriculum development, completed in the 1960's, a decade of activity and experimentation" (Starkweather, 1986, p. 3).

The last decade has been a time of change for our profession. In 1985 the professional organization for industrial arts teachers, the American Industrial Arts Association, changed the name of industrial arts to technology education and the name of the association to the International Technology Education Association. However, there was more at stake than just a name change.

The focus on industrial technology to global technology is taking place in the development of curriculum materials for the profession. So to better reflect curriculum developments of the profession and to provide the necessary opportunities and competence to function in a technological society, the name was changed to better reflect our world and the goal of making students technologically literate. Therefore, the emphasis was taken off the study of industry and placed on all technology found in our world.

The literature over the years in the industrial arts has focused on the subject matter of industry and technology. A book titled, Teaching Children about Technology by Mary-Margaret Scobey (1968) points out, "the major emphasis of education is to provide young children knowledge and skills necessary for a life in a technological culture" (p. 7). Further, Scobey and Graham elaborates that "industrial arts can reinforce almost all subject matter areas of the curriculum" (1974, p. 7).

Technology education has been defined as "the school discipline for the study of the application of knowledge, creativity, and resources to solve problems and extend human potential" (Technology Education Advisory Council, 1988, p. 16).

The International Technology Education Association publication, Technology Education: A Perspective on Implementation (1985), distinguished the following goals, for preparing students for the world in which they live:

1. know and appreciate the importance of technology
2. apply tools, materials, processes, and technical concepts safely and efficiently
3. uncover and develop individual talents
4. apply problem-solving techniques
5. apply other school subjects
6. apply creative abilities
7. deal with forces that influence the future
8. adjust to the changing environment
9. become a wiser consumer
10. make informed career choices (p. 25).

Teaching technology education at the elementary school level, with its goal of making students aware of their technological world, is in its infancy in our public school curriculum. To fully understand the above statement, the following observations about people, technology, and our society have been developed by the ITEA Technology Education Advisory Council (1988).

- Technology has changed and will continue to change society.
- Complex societal issues have evolved from technological developments.
- Citizens must be prepared to understand technological innovation, the impact of technology on the quality of life, and the need for critical evaluation of societal changes resulting from technological advances. (p. 16).

Establishing Technology Education In The Elementary School

Technology education at the elementary school can make numerous contributions to the existing curriculum. Further support for integrating the study of technology into the elementary school is offered by Peterson (1986). He states, "The elementary school level is where the development of an essential understanding of technology should begin. Technology constitutes a universal element within all cultures and provides an important requisite for cultural survival" (p. 47). To further integrate the study of technology in the elementary school curriculum, Smalley (1986), reported "Technology education should <u>extend</u> into the elementary school...if technology is to be adequately understood it will have to start in the elementary school as it relates to the man-made world" (p. 188).

However, the first writings focusing on technology education (industrial arts) at the elementary school were published by Frederick Bonser in 1923. Bonser noted that the study of industry and investigations thereof "includes a body of ideas and meanings, and of interpretative and expressive activities, attitudes, and habits" (1930, p. 30). Further, Bonser believed that incorporating technology education (industrial arts) into the elementary classroom provided an "aim acquiring useful information and cultivating desirable attitudes" about the world (1923, p. viii). The first doctoral research in the area of elementary school industrial arts began in 1930 (Downs, 1974, p. 239).

During the first quarter of the Twentieth Century, Bonser and Mossman stood out as leaders in the attempt to incorporate industrial arts into elementary school curriculum. Their undertaking developed into a published book, Industrial Arts for the Elementary School. Hostetter (1974), reported that their book "suggested that much learning could be associated with activities related to six areas, namely: food, clothing, shelter, tools, utensils, and records" (p. 218). The following key elements of Bonser's ideology are accounted by Hoots (1974).

1. Industrial arts is a subject matter discipline and has its own unique body of content.

2. Industrial arts derives its content from industry, with emphasis on man's changing of raw materials into useful products, from the life related to these changes, and from the consumer aspect of utilizing products.

3. Industrial arts is a part of the total school curriculum and has a close relationship to the other subjects within the curriculum.

4. The elementary school classroom teacher must provide industrial arts instruction at the elementary school level. (p. 222)

During the late 1960's and early 1970's, numerous reports and articles in the technology education profession surfaced stressing the study of technology in elementary school. In 1971, a National Conference for Elementary School Industrial Arts was held in Greenville, North Carolina to clarify the significance of integrating the study of technology in the elementary school. This conference was sponsored by the U.S. Office of Education. At that conference, Hoots (1971) made the following statement regarding integrating the study of technology into the elementary school curriculum:

> It deals with ways in which man thinks about and applies scientific theory and principles to change his physical environment to meet his aesthetic and utilitarian needs. It provides opportunities for developing concepts through concrete experiences

> which include the manipulation of materials, tools, processes, and other methods of discovery. It includes knowledge about technology and its processes, and other methods of discovery. It includes knowledge about technology and its processes, personal development of psychomotor skills, and attitudes and understandings of how technology influences society. (p. 3)

Beginning in 1923 (Bonser), the study of technology or industrial arts in the elementary school has been regarded as a meaningful component of every student's education. Scobey and Graham concluded that "Its content, attitudes and psychomotor skills are regarded as appropriate learnings for all children. They will be needed by all children as they grow, mature, and become socially and economically independent" (1974, p. 31).

The MISSION 21 Project

The National Aeronautics and Space Administration (NASA) realizes the need to take a determined position in the advancement of technological literacy in America's schools. Beginning with Operation Liftoff, NASA made a commitment to become more involved in the development and distribution of educational materials that center on the elementary school community. This initiative was devised to inspire student's inquisitiveness in the study of technology, mathematics, and science in an effort to assure their active participation in an expanding technological society.

As part of this initiative, NASA awarded a training grant to the Technology Education Program Area in the College of Education at Virginia Polytechnic Institute and State University (Virginia Tech) in June 1985. This grant enabled the Technology Education Program Area at Virginia Tech to hire graduate students to work with faculty to develop the rationale and structure for an innovative program to promote technological literacy in the elementary school. This funding also provided the resources to develop a teacher's technology education resource guide including student activities. The program, titled Mission 21, has the goal to make students technologically literate for the 21st century.

Mission 21 is a technology education elementary project designed to integrate the study of technology through existing elementary curriculum. Mission 21 was developed for the elementary school curriculum with a deliberate focus on technology awareness. The primary objective of Mission 21 was to structure an "... innovative program to promote technological literacy in the elementary school through a problem-solving approach" (Virginia Tech, 1989, p. 5).

specific contributions are consistent with the basic purposes listed in Standards of Learning Objectives for Virginia Public Schools (1989). Mission 21 is a first through sixth grade technology education activity program. However, this study is limited to only the third and fourth grade segment of the overall Mission 21 project.

Mission 21 began in June of 1985, focusing on developing materials aimed solely at the fifth and sixth grade student population. Not until August of 1987, was funding received to expand teacher and student materials for the third and fourth grade. For example, the third and fourth grade Mission 21 Resource Guide provides twenty-two activities for teachers to use with their students.

The third and fourth grade Mission 21 resource guide helps elementary school teachers implement technology education concepts into their existing curriculum. For a curriculum of any kind to be effective, Mojkowski points out that, "The absence of any serious study and documentation of technology applications that do or do not work constitutes a serious gap in our knowledge base about curriculum integration. We must document and analyze our successes and failures in order to make any substantial progress" (1987, p. 118). The Mission 21 project has also been a dynamic process, always evolving to better prepare students about the technological world that surrounds them.

From the beginning, Mission 21, was developed as a student-centered curricula about technology rather than a subject-matter content curriculum guide. To develop effective technology education curriculum for the elementary school level that provides students with a fairly balanced concept of technology, it is imperative to determine student attitudes about technology.

The third and fourth grade Mission 21 project is separated into four themes that include: (a) Machines, (b) Discovery, (c) Community, and (d) Connections. The Machines theme allows students to examine basic machines, determine the impact machines have on human lives, and how machines solve problems. The Discovery theme provides students the opportunity to explore how technology makes it possible to make new discoveries, how discoveries have led to useful things, and both the positive and adverse impacts of technology on society. Students resolve dilemmas in the Community theme on how to improve the quality of life in a community, the role technology plays in working out community problems, and environmental concerns. The last theme is titled Connections. Activities in the Connections theme have children identify the connections between natural resources and products of technology, technology and value judgments, and predicting impacts of technology.

Technology education activities for the third and fourth grade focus on technology that students use or are exposed to in everyday living. This is consistent with Hoots (1971) who stated that "children must learn about the world in which they live if they are to be expected to be productive and useful citizens in the world tomorrow" (p. 1).

Student activities found in the Mission 21 teacher resource guide are called "Design Briefs". According to Pinder (1990) Design Briefs originated in the United Kingdom as "White Papers". White Papers suggested the use of legal briefs taken from the legal profession. A design brief depicts a situation, which is usually hypothetical, and requests a solution to a given problem. The purpose of the design brief is to encourage the student to think creatively while using the problem-solving process to explore alternative solutions and make decisions regarding the optimal solution to the problem. Students learn how to use and adapt technology to meet their needs during a Mission 21 activity. Shepard (1989) discovered students "will also be developing knowledge and skills right across the curriculum" (p. 8).

Research Relating Directly To The Problem Statement

Contributions to the development of technological literacy at the elementary school level, can be accomplished by researching attitudes toward technology among elementary school students. Goldman and Kaplan (1976) concluded that "because of the importance of the issue of technological change, it is important to measure attitudes toward technology" (p. 1).

Research conducted on attitudes towards technology by de Klerk Wolters (1989c) found that "For education it yields the advantage that it offers a guiding framework for curriculum development" (p. 13). The work conducted by de Klerk Wolters agrees with that of Koballa and Crawley (1985). They stated that "attitudes are learned predispositions acquired over a period of time rather than being inherited traits" (p. 595). To develop technology education curriculum materials for the elementary school, it is essential to identify student attitudes about technology. According to de Klerk Wolters research on attitudes of pupils toward technology (1989a), "little research has been done in this field" (p. 3). This study will add research data to what little research has been already completed for developing technology education elementary curriculum.

PATT Research

Student attitudes toward technology has been the focus of technology education in many countries and most recently, in America. Beginning in 1985, a project titled Pupils'

Attitudes Towards Technology (PATT) emerged from the Department of Physics Education at Eindhoven University of Technology in Eindhoven, Netherlands under the direction of Raat and de Vries. The purpose of the PATT project according to de Klerk Wolters (1989b), "is to investigate what pupils' think of technology and to use the results of this research for the development of the new subject technology in primary and secondary education" (p. 291). Educators, researchers, and administrators in eleven countries conducted pilot studies with translated questionnaires. This research grew out of a need to develop technology education curriculum materials.

In March of 1986, the first of an annual series of conferences titled, "Pupil's Attitudes Toward Technology" (PATT) was held at the Eindhoven University of Technology in Eindhoven, Netherlands. Since 1986, this yearly conference and workshop has been held at different locations all over the world. The purpose of this conference/workshop was for technology educators from all of the world to share and discuss research relating to pupils' attitudes toward technology. Outcomes from this research were directly reflected into the development of technology education curricula. In 1989, Bame and Dugger reported that "more than twenty countries were involved with the Pupils' Attitude Toward Technology (PATT) research" (p. 1).

During the first PATT conference, Raat and de Vries (1986) reported that they had begun investigations into the concept of and the attitude towards technology. Their research focused on students who were in the thirteen year-old age group. Findings from their study reported that "It appears that the concept these pupils have of technology is obscure and there were many gaps in it. There were many significant differences between boys and girls as far as their attitude towards technology is concerned" (Raat & de Vries, 1986, p. 13). By the fourth PATT conference held in April of 1989, over thirteen countries including the USA had conducted over twenty pilot studies into the investigation of Pupil's Attitudes Towards Technology. All participating countries used identical instruments except for the language conversion.

From the PATT literature reviewed, it was remarkable that PATT findings and results of pupils' attitudes to and knowledge of technology were very comparable across all countries studied. Further, de Klerk Wolters (1989a) reports that "the results from the different domains are in almost complete agreement. This finding is important in demonstrating the validity of PATT studies" (p. 303). PATT research was a method of obtaining information with realistic connotations for evaluating student attitudes about technology and technology education curriculum.

PATT research directed by Bame and Dugger (1989) in America was conducted with thirteen to fifteen year-olds enrolled in existing technology education/industrial arts programs. In other countries where the PATT instrument was administered, the age group was consistent However, student exposure to formal technology education/industrial arts programs was not. The PATT instrument has never been administered to third or fourth grade level students. The original PATT instrument used in America, could not be used in its original form for this study. The PATT-USA instrument could not be used due to the length of the instrument (100 items) and the reading level.

Data gained from PATT research can be broken up into four areas. These areas include: (1) pre-information for curriculum development, (2) information for technology educators, (3) evaluation of technology education programs, and (4) information for teacher education. However, for the purpose of this study, data gained from this study will be used for post evaluation of Mission 21 curriculum. This research may determine: (a) are there gender differences?, (b) do student definitions of technology in the treatment group reflect Mission 21 activities?, (c) is there a difference in definitions of technology between the treatment group and the control group?, (d) does participation in the Mission 21 program affect third and fourth grade student attitudes toward technology?, and (e) is there a difference between third and fourth grade student attitudes toward technology?

The conference proceedings from the 1989 PATT-4 conference held in Eindhoven, Netherlands list the four main arguments that justifies PATT research:

- it permits to confront pupils' views with views of others, e.g. experts,
- it gives clues for curriculum development,
- it gives information about students' needs and students' interest,
- it permits curriculum development that is more student-centered than subject centered. (p. 291)

The outcomes of research obtained from PATT (de Klerk Wolters, 1989a) stated that "the design and development of new technology curricula provides certain preconceptions of technology and interests in technology of pupils that are taken into account more explicitly than before" (p. 126).

Research conducted by de Klerk Wolters (1989c) reported PATT outcomes focusing on the ten to twelve year old age group. He stated that, "As in the case with older age groups, 10-12 year-olds had a positive attitude toward technology. However, boys scored significantly higher on the positive attitude scales than girls ($p < .001$). Ten to twelve year old boys also wanted to hear more about technology and considered technology to be more important than girls did" (p. 27).

Research on attitudes toward technology in America has been conducted by Bame and Dugger (1989). The PATT-USA report compiled over ten thousand responses from a total of seven states. The data were collected from sixth and seventh grade students who were enrolled in technology education/industrial arts classes. The instrument used to measure "pupils' attitudes toward technology" incorporated a Likert scale for measurement as have previous PATT studies. Since the original PATT instrument was developed and administered in the Netherlands, the instrument was written in Dutch. For this instrument to be administered in America, an obvious language translation (Dutch to English) had to take place.

Marc de Vries from the Eindhoven University of Technology came to Virginia Tech and spent the summer of 1988 making the appropriate changes. de Vries (1988) conducted the following research to make the original PATT instrument possible in America:

1. The language of the English translation of the PATT Likert questionnaire was checked for non-American expressions and words. A few minor changes were made;
2. the Likert questionnaire was field-tested with a sample of 200 pupils in grade six and seven of five

junior high and middle schools in various parts of Virginia; in addition to this 100 other students of the same schools wrote an essay on "What I think of technology"; to see whether the instruction for the teachers to administer the instrument functions properly, the researchers visited four of the five schools and watched the administration of the questionnaire. Essays were written afterwards and sent back to Virginia Polytechnic Institute and State University.

3. the results of this field-testing were analyzed and have lead to modifications of the instrument; The analysis consisted of: a frequency analysis of all measured variables, a factor analysis of the attitude items, a Guttman analysis of the concept items, a reliability analysis of the concept items, t-tests on the attitude and concept scale scores with subgroups based on sex, grade, rural or urban school area, parents' profession, technological climate at home, quality of a definition given by the students in the questionnaire. (p. 6)

In reporting de Vries's (1988) Virginia field-test work on the essay categories centering on "What I think technology is", the following groupings emerged:

Concept	boys (N=64)	girls (N=21)	total (N=85)
1. Influence on life/society	25	7	32
2. Historical dimensions	5	0	5
3. Only of today and future	10	2	12
4. Technology = machines/tools	5	3	8
5. Technology = humans/people	7	1	8
6. Technology involves materials	3	2	5
7. Technology = knowledge	15	7	22
8. Science	9	1	10
9. Inventions/discoveries/progress	24	1	25
10. Making things	19	10	29
11. Using tools/machines	28	11	39
12. Safety	6	3	9
13. Computers	19	5	24
14. Wood(work)	9	8	17
15. Metals	4	1	5
16. Electrical appliances	13	3	16
17. Transportation means	14	3	17
18. Industry/(mass) production	13	4	17
19. Jobs	8	3	11
Attitude			
20. Fun/interesting	10	7	17
21. Positive consequences	17	4	21
22. Negative consequences	5	1	6
23. Important as school subject	4	2	6

(p. 33).

Outcomes reported by Bame and Dugger (1989) were very similar to those reported by de Klerk Wolters and de Vries. Junior high/middle school and high school students (ages 12-15) had a positive attitude towards technology. "Boys indicated a more positive attitude toward technology than girls ($p < 0.01$) but perceived technology as being more difficult" (p. 43). Further, "boys appeared to be more knowledgeable about technology than girls" (p. 44).

Bame and Dugger (1990) reported the following findings from their PATT-USA research:

1. Boys indicated a greater interest in technology than girls.
2. Boys rated technology as having more consequence than did girls.
3. The girls viewed technology as being an activity for both boys and girls to a greater extent than do the boys.
4. There was a significant difference between boys and girls on their knowledge about technology (i.e. boys appear to be more knowledgeable.
5. The general interest in technology of older students was significantly greater than that of those who were younger.
6. There was no direct relationship between grade level and the view that technology is an activity for boys and girls.
7. Having a personal computer in the home had a significant positive effect on their general interest in technology.
8. Taking or having taken Technology Education/ Industrial Arts made a significant difference on all attitude scales, as well as the concept scale.
9. Students who took Technology Education/Industrial Arts classes displayed a greater knowledge about

technology than did students who had no exposure to the class. (pp. 3-4)

Bame (1990) reported that after reading over thousand statements from the states of Virginia and New Jersey on "What do you think technology is", the statements mainly reflected "technology is machines, technology is science, technology effects humans or is created by humans, technology is computers, or technology is what I do down in the shop".

Other Research On Student Attitudes Towards Technology and Science

A considerable number of papers, investigations, and findings from over all the world, have been completed about students' attitudes towards science. The science education community regards..."the study of attitudes a significant factor in determining the effectiveness of science education curriculum" (Schibeci, 1984, p. 5). Further, Ormerod and Duckworth (1977) stated that, "there has been sufficient work showing the importance of attitudes of pupils in Britain, America, and elsewhere, to provide clues which enable teachers and curriculum developers to design curricula which would improve those attitudes" (p. 2). Science educators and curriculum developers have long looked at student attitudes toward science, when developing curriculum. In 1977, Ormerod and Duckworth found that, "research findings as well as common sense suggests, therefore, that the attitudes and interests of pupils are likely to play an important part in any satisfactory explanation of the variable levels of performance shown by pupils in their school science subjects" (p. 2).

Further support for developing positive attitudes about technology in elementary school students is suggested by Nannay (1989). He stated, "Foremost is the development of positive attitudes toward the family and its importance to society" (p. 5). Throughout all literature reviewed for this study, none was found pertaining to attitudes about technology from third or fourth grade students.

Attitude Measurement

Numerous materials, research, and investigations have been written about the concept of attitudes. A thorough review of attitude research suggests that beginning in the year 1918, attitude developed as a modern concept. However, not until 1929 did Thurstone generate a method to measure attitudes by a means of scales. Further, in 1932, Likert developed a more sensible technique for measuring attitudes. For educational attitude research purposes, it should be mentioned that besides the Thurstone and Likert measurement scales, the Guttman and Semantic Differential scales are used as well. de Klerk Wolters reported that, "Likert scales are the most frequent means of attitude measurement" (1989a, p. 21). The instrument developed for this study contains only twenty items. Thus, a revised Likert format using two scales (yes or no response) was incorporated. "Likert scales yield higher reliabilities with fewer items than Thurstone scales" (German, 1988, p. 702).

Raat and de Vries (1985) designed an instrument to measure Pupils' Attitudes Toward Technology for pupils in the ten to eighteen year old age group. Raat and de Vries (1985) found their instrument to be valid and a reliable (r=.67) means of measuring pupils' attitudes toward technology as did Bame and Dugger (1989) in measuring thirteen to fifteen year-olds in America.

Attitude has been defined by Webster's Ninth New Collegiate Dictionary (1988) as "a mental position with regard to fact or state and a feeling or emotion toward a fact or state" (p. 114). For measurement purposes, attitudes have been broken up into three individual elements. According to de Klerk Wolters (1989a) these include, "affection (feeling), cognition (knowledge), and conation, (behavior)" p. 4). For purposes of this study, only the affection and cognition components of attitudes were measured. The reading level of the students and the limited complexity of the instrument had to be reduced because of the short attention span of the students at this grade level.

Measuring affective and cognition objectives in education is important because: "1. affective objectives determine (together with the cognitive objectives) the individual's capacity to participate effectively in society; 2. in order to obtain cognitive success pupils must also have a positive attitude towards the subject in question" (de Klerk Wolters, 1989a, p. 6).

The results of this study will provide school systems, curriculum developers, and the technology education profession information about students and the study of technology in the elementary school.

Summary

This chapter was concerned with the justification for inclusion and measurement of technology education in the elementary school curriculum. Technology has and will continue to be one of the most widespread influential factors American society as well as throughout the world. Mission 21 content and integrative practices in existing elementary school curriculum is consistent with the Virginia Standards of Learning Objectives, principles of learning, and child growth and development.

Until now, no formal research has been conducted to determine third and fourth grade student attitudes toward technology. The study was significant because there was an innovative technology education elementary curriculum provided to one group of students, and secondly attitudes measured from this group will be compared to the same grade level students who did not receive this treatment. In effect, this was one way to determine the effectiveness of this curriculum project and to provide technology education elementary curriculum developers data in which to base learning objectives and activities in the future.

CHAPTER THREE

The Design and Methods of the Study

This chapter describes the design and methods of the study including the subjects, research design, general procedures, instrumentation, hypotheses, and analysis of data.

The Sample

The sample of this study consisted of 858 third and fourth grade elementary students attending urban, suburban, and rural elementary schools in the Commonwealth of Virginia. Of the 858 third and fourth grade students used in this study, 459 students were in the treatment group and 399 students were in the control group. These public elementary schools were located in Herndon, Hillsville, Newport News, Norfolk, and Pembroke, Virginia. Third and fourth grade students enrolled in these geographic areas made up the population for this study.

Permission to conduct the third and fourth grade Mission 21 project was requested of, and granted by, administration personnel at Dranesville and Clearview Elementary Schools in Herndon, Virginia, Hillsville Elementary School in Hillsville, Virginia, Carver Elementary School in Newport News, Virginia, Willard Model School in Norfolk, Virginia, and Eastern Elementary School in

Pembroke, Virginia (See Appendix 1 for letter of permission). The grade level and number of students in each school are listed in Table 1. Teacher and principal observations reported that students involved with Mission 21 activities were from varying socioeconomic backgrounds, academic abilities, and ages.

The Design of The Study

The treatment group of students in these elementary schools were exposed to between five and fifteen Mission 21 design brief activities over a period of at least five months. The treatment for influencing student attitudes about technology was the third and fourth grade Mission 21 program. Students used in the treatment group were not randomly chosen.

The Mission 21 design brief activities that students were exposed to in this study were chosen by individual classroom teachers integrating Mission 21 into their existing elementary classroom curriculum. Classroom teachers had the option of choosing any design brief from any of the four themes found in the Mission 21 Teacher Resource Guide. Students tested in this study were not exposed to third grade Mission 21 activities in the 1989-90 school year. Appendix 2 lists all third and fourth grade Mission 21 themes and design briefs. Teachers involved with

Table 1

Number and Grade Level of Students From Each Mission 21 Field-Test Site School (treatment and control groups)

School	Grade Level	No. of Students
Urban Schools		
Carver Elementary	Third	67
Carver Elementary	Fourth	84
Willard Model School	Third	34
Willard Model School	Fourth	36
Suburban Schools		
Dranesville Elementary	Third	107
Dranesville Elementary	Fourth	138
Clearview Elementary	Third	48
Clearview Elementary	Fourth	92
Rural Schools		
Hillsville Elementary	Third	62
Hillsville Elementary	Fourth	56
Eastern Elementary	Third	58
Eastern Elementary	Fourth	76
Total		858

this project participated in a five to eight hour inservice on how to integrate Mission 21 into their elementary classroom curriculum. During the inservice, teachers were provided the history and goals of Mission 21, the role of technology education in the public school, how to integrate Mission 21 into existing elementary curriculum, the relationship between science and technology, and actual, "hands on" experience completing a problem-solving design brief. All Mission 21 teachers were allowed to choose which design briefs would be field tested in their classroom. Third and fourth grade Mission 21 teachers located in the same school decided which themes they would integrate into their own classroom curriculum so no overlap of Mission 21 activities would occur.

The control group for this study consisted of those students not exposed to Mission 21 design brief activities. These students were either third or fourth grade students, enrolled at the same school as the treatment group students. As with the treatment group, students in the control group were not randomly assigned.

Before administering the "Student Attitudes Toward Technology" Instrument (SATT), six classes in three different schools not involved with the field-testing of Mission 21 materials were selected to field-test and validate the instrument. These three schools were located in Fairfax County, Virginia, Newport News, Virginia, and Pearisburg, Virginia. All three schools used to validate the instrument were of comparable demographic backgrounds, academic and age groupings, and socioeconomic status. The purpose of field-testing the instrument was not only to validate the instrument, but to watch students take the instrument to determine any problems associated with wording and teacher administration of the instrument.

In the major study, student attitudes toward technology were determined from students who had completed between five and fifteen Mission 21 design brief activities over the course of five months. To determine the effectiveness of Mission 21 activities, student attitudes about technology were also measured among students not exposed to Mission 21 activities.

The circumstances dictated at which schools Mission 21 was conducted. For example, previous Mission 21 schools working with the fifth and sixth grade portion of the project, were asked to identify third or fourth grade teachers that would be willing to field-test the third and fourth grade Mission 21 curriculum materials. Since supervisors, principals, and teachers in participating schools were already familiar with the Mission 21 project, field-testing third and fourth grade materials did not present a problem.

Hypotheses

In a study of this type, there are many questions that the researcher tried to answer. Some of these questions came out of the researcher's background and experience while working with this new innovative technology education elementary curriculum project, titled Mission 21. The remaining questions were those posed by previous PATT research (Raat, de Vries, de Klerk Wolters, Bame, and Dugger).

Since the beginning of the Mission 21 project in 1985, there had been no research on student attitudes toward technology, or what students thought technology was, or comparing students who have or had not been exposed to Mission 21 activities. With this question in mind, the researcher desired to determine the effectiveness of Mission 21 in terms of student attitudes toward technology and definitions of technology. This study tested ten separate hypotheses and one research question, each drawn from the research questions presented in Chapter 1.

<u>Hypothesis 1.</u> There is no difference in the attitudes of girls and boys toward technology.

<u>Hypothesis 2.</u> There is no difference between the treatment or control group attitudes toward technology.

<u>Hypothesis 3.</u> There is no difference between third and fourth grade student attitudes toward technology.

Hypothesis 4. There is no difference between student attitudes toward technology in urban, suburban, and rural schools.

Hypothesis 5. There is no interaction of gender and treatment on attitudes toward technology.

Hypothesis 6. There is no interaction between gender and grade level on attitudes toward technology.

Hypothesis 7. There is no interaction between grade levels and treatment on attitudes toward technology.

Hypothesis 8. There is no interaction between gender and geographic area on attitudes toward technology.

Hypothesis 9. There is no interaction between grade levels and geographic areas on attitudes toward technology.

Hypothesis 10. There is no interaction between treatment and geographic areas on attitudes toward technology.

Research Question 1. How do the students who have had Mission 21 differ in their definitions of technology from those who were in the control group?

Research Design

The design used for this study was quasi-experimental using the posttest-only design with nonequivalent groups. Figure 1 shows the diagram for this design. The diagram shows that (1) two groups (treatment and control) are used

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X     O
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      O
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Figure 1. Diagram of the posttest-only nonequivalent control group design.

(two rows in the figure); (2) (X) is the Mission 21 design briefs given to the treatment group; (3) both groups are measured (O) at the same time after the Mission 21 design briefs have been administered to the treatment group.

According to Cook and Campbell (1979) the posttest-only design with nonequivalent groups is:

> ...a treatment that is implemented before the researcher can prepare for it, and so the research design is worked out after the treatment has begun. Such research is often said to be ex post facto. We shall understand ex post facto here in a more restricted sense than is often used--as research where there are no pretest observations on the same or equivalent scales for which posttest observations are available (p. 98).

External validity concerns for posttest-only designs, focuses on the question of how generalizable the results are. Further, Cook and Campbell (1979) stated that "External validity refers to the approximate validity with which we can infer that the presumed causal relationship can be generalized to and across alternate measures of the cause and effect and across different types of persons, settings, and times" (p. 37). Huck, Cormier, and Bounds (1974) point out that "quasi-experimental designs can have greater control over external threats to validity. For example, researchers who use a quasi-experimental design with naturally formed or intact groups will probably decrease subject reactivity" (p. 302). Both the control and treatment groups used in this study were intact groups. For the purpose of this study, the 0.05 level of significance was used to conduct and report results.

Internal validity influences the confidence that the results of the research can be based on the design of the study. Cook and Campbell (1979) define internal validity as "the approximate validity with which we infer that a relationship between two variables is causal or that the absence of a relationship implies the absence of cause" (p. 37). For the purpose of this study, internal validity determined which instrument questions had a causal relationship from one variable to another. Pertinent to the concern of internal validity are seven different extraneous variables, if not taken into consideration, might produce effects obscuring the effect of the treatment. Cook and Campbell (1979) report they represent the effects of "(1) History, (2) Maturation, (3) Testing, (4) Instrumentation, (5) Statistical Regression, (6) Selection, and (7) Mortality.

History can be a threat "when an observed effect might be due to an event which takes place between the pretest and posttest" (Cook and Campbell, 1979, p. 51). History was not a threat in the study because only a posttest was administered.

Maturation "is a threat when an observed effect might be due to the respondent's growing older, wiser, stronger, more experienced, and the like between pretest and posttest" (Cook and Campbell, 1979, p. 52). Maturation did not effect the results of this study because only a posttest was administered.

Testing can be a threat to internal validity "due to the number of times particular responses are measured. In particular, familiarity with a test can sometimes enhance performance because items and error responses are more likely to be remembered at later testing sessions" (Cook and Campbell, 1979, p. 52). Since the Student Attitudes Toward Technology Instrument was only administered once to both treatment and control groups, students did not have the chance to familiarize themselves with individual items or responses. Therefore, the internal validity threat, testing, was not a problem for this study.

Instrumentation can be threat to internal validity "due to a change in the measuring instrument between pretest and posttest and not to the treatment's differential impact at each time interval" (Cook and Campbell, 1979, p. 52). Instrumentation was not a threat to this study because only one posttest measure was used.

Statistical regression "operates to increase obtained pretest-posttest scores among low pretest scores, since the group's pretest scores are more likely to have been depressed by error" (Cook and Campbell, 1979, p. 52). Statistical regression was not an internal threat to validity in this study because no pretesting was done.

Selection can be a threat to internal validity "due to the difference between the kinds of people in one experimental group as opposed to another" (Cook and Campbell, 1979, p. 53). The researcher attempted to control selection as a threat through the use of multiple classes, teachers, and geographic areas.

Mortality is a threat "when an effect may be due to the different kinds of persons who dropped out of a particular treatment group during the course of an experiment" (Cook and Campbell, 1979, p. 53). Since only a posttest measure was used in this study, mortality did not effect the results of the study.

The statistical design used in this study was the factorial analysis of variance. The main effects and interactions of hypotheses one through ten were tested.

Instrumentation

The instrument used in this study was a modified version of Pupils' Attitude Towards Technology - USA scale.

The PATT-USA instrument was developed in conjunction with the Technology Educati n Program Area at Virginia Tech and the Department of Physics Education at Eindhoven University of Technology in Eindhoven, Netherlands. The instrument's original form was intended for sixth through ninth grade students. However, to be applicable for third and fourth grade students used in this study, the instrument had to be shortened and reading level lowered. For this instrument to be useful with both the treatment and control groups, it was designed to be used with third and fourth grade students who had not been exposed to Mission 21 activities.

Seventeen statements where used from the original PATT-USA instrument. The remaining three questions pertained directly to demographic information about students (gender, grade level, and age). The 17 statements chosen from the original PATT-USA instrument were picked by choosing those attitude toward technology statements that correlated highest among the pilot sample to three of the four variables used in this study (gender, grade level, treatment/control).

The instrument used in this study as well as the original PATT-USA instrument is a paper and pencil instrument. Students circled either "yes" or "no" to 19 of the 20 questions. Students had to write in their age for the other question. Before students were exposed to the 20 questions, they were asked to give a short description of "what do you think technology is". Each of these descriptions of technology were keyed into <u>The Ethnograph Program</u> to determine the frequency of definitions of technology used by both groups of students used in this study.

Students answered 17 attitude statements about technology. Each instrument was scored by adding up the total number of "yes" and "no" responses for each instrument. The correct answer for some items on the SATT instrument was no. To expedite the tallying of the SATT instrument scores, those responses that had a correct answer of no, were transformed into a yes response before the factorial anova of variance was computed. The greater number of "yes" responses recorded on the instrument, indicated a more positive attitude toward technology. Elementary school teachers and administrators who evaluated the instrument used in this study, repeatedly indicated that statements used in this study should be positively worded. As a result, the Student Attitudes Toward Technology instrument used in this study had no negatively worded statements regarding technology. For data analysis purposes, the lower the mean score on the instrument indicated a more positive attitude towards technology.

Before the final instrument was administered to students in this study, the instrument was field-tested with three separate elementary schools not used in the original Mission 21 field-test site schools. All three of these instrument field-test site schools were of comparable geographic areas and student population to that of Mission 21 field-test sites. The purpose of field-testing this instrument was to assure adequate internal consistency, reliability, readability, and to determine what problems students would encounter in taking the instrument. Teachers who participated in field-testing this instrument were asked to identify areas or wording of questions that were unclear to students. Information obtained from these teachers was incorporated into the final instrument draft. To obtain a third and fourth grade readability for this instrument, the instrument was processed by using the FOG index, using RightWriter software. A 18.60 FOG index was calculated by RightWriter on the SATT instrument. Third and fourth grade elementary teachers not involved with the field-testing of Mission 21 materials, Mission 21 project staff members, and administrators also reviewed the instrument for appropriate readability and understanding.

The reliability of the original PATT instrument reported by de Klerk Wolters (1989) was greater than .70 for all research groups. Reliability in this study means internal consistency of the test in measuring student attitudes toward technology. Reliability tends to be higher when groups of children are measured, rather than measuring individuals (Henerson, 1978). Kerlinger (1986) points out that "...the greatest emphasis is usually put on construct validity, since it is probably the most important form of validity from the scientific research point of view" (p. 417). The validity of the PATT instrument reported by de Klerk Wolters (1989) was determined by content, concurrent, and construct validity. For this study, content validity was used to validate the instrument due to the limited number of questions used in the instrument.

Threats to both internal and external validity were a major concern for this study. Asche (1983) lists seven threats to internal validity. These include "low statistical power, violated assumptions of statistical tests, fishing and error rate, reliability of measures, reliability of treatment administration, random irrelevancies in the experimental setting, and random heterogeneity of respondents" (p. 15). Of the listed threats to internal validity, the reliability of treatment administration is the hardest to control. The researcher was unable to personally administer the instrument to all groups of students. A standardized instrument instruction sheet was provided to all classroom teachers to administer the instrument. Before the actual instrument was administered in this study, a panel of experts reviewed and made comments. This panel consisted of Mission 21 curriculum developers and writers, PATT researchers, third and fourth grade teachers not involved with implementing Mission 21, school system and NASA administrators. This was provided to reduce test-taking variation and to standardize the instrument taking procedure.

The results of this study are generalizable to populations and settings comparable to the educational and demographic groups used in this study. Further, O'Reilly (1983) points out that to increase the external validity of the study, the researcher could use the "model of deliberate sampling for heterogeneity" (p. 37).

General Procedures

After the population was identified, teachers, principals, and supervisors were contacted to allow the field-testing of the third and fourth grade Mission 21 materials. Individual meetings with teachers, principals, and supervisors in the selected elementary schools were held. In each of these meetings, the proposed research was explained and endorsement was sought to conduct the research. After authorization was granted from the participating elementary schools or school systems, dates and times of testing were arranged that were convenient for the participating teachers.

Collection of Data

Individual instruments for students were either mailed or hand delivered to each of the field-test site teachers and cooperating control group teachers. Individual schools, teachers, and students participated on a voluntary basis and anonymity was guaranteed. Students took approximately 15 minutes to complete the instrument. Teachers were provided self-addressed, postage paid envelopes to return the completed instruments to the researcher. Individual instruments were scored by hand and the data was entered into an IBM Model 50 microcomputer. Student responses regarding their definition "what do you think technology is" were entered into The Ethnograph Program, version 3.0, to determine the frequency of technology definitions. Student responses for attitudinal data were entered into Number Cruncher Statistical System, version 5.x, for statistical processing.

Analysis of the Data

Analysis procedures included the calculation of descriptive and frequency statistics of the study, grade levels, and demographic areas. Further, factorial analysis of variance was used to determine any statistically significant differences, main effects, and interactions at the 0.05 alpha level. The Number Cruncher Statistical System (Hintze, 1989) was used to conduct the factorial analysis of variance. Cronbach's homogeneity coefficient alpha was employed to determine the reliability and internal consistency of Student's Ideas of Technology Instrument used in this study.

To determine the frequency of "what do you think technology is" definitions, The Ethnograph Program (Seidel, Kjolseth, and Seymour, 1988), version 3.0, was utilized. The purpose was to compare definitions of technology from both Mission 21 students (treatment group) and students not exposed to Mission 21 (control group).

Summary

This chapter delineated the design and methods of this study, including the demographic area of subjects used in the population, research methodology, general procedures, instrument validation, hypotheses tested, and analysis of data.

This study used a population of 858 third and fourth grade students attending suburban, rural, and urban elementary schools in the Commonwealth of Virginia.

A quasi-experimental design employing posttest-only design with nonequivalent groups was used in this study.

Students were tested using a modified Pupils' Attitudes Toward Technology - USA scale. Each hypotheses in this study was tested using factorial analysis of variance.

Attitudes measured in this study came from third and fourth grade students. Student attitudes toward technology were measured from students exposed to Mission 21 activities and students not exposed to Mission 21 activities. These two groups of students were taught by separate classroom teachers.

CHAPTER FOUR

Results of the Study

The purpose of this study was to compare student attitudes toward technology and student definitions of technology of third and fourth grade Mission 21 students to a corresponding control group. The study population was restricted to students in six elementary schools in Virginia. Comparisons were made on the basis of gender, grade level, treatment or control, and geographic area. The research design used for this study was quasi-experimental using the posttest-only design with nonequivalent groups.

The statistical analysis of the data was completed by using an IBM Model 50 microcomputer. The Number Cruncher Statistical System (NCSS) program was selected and the subprograms utilized were "Spreadsheet", "Transformations", "Descriptive Statistics", and "GLM-ANOVA" (Hintze, 1989).

Analysis was conducted to describe the four independent variables (gender, grade level, treatment or control, and geographic area). The dependent variable in this study was student attitudes toward technology as measured by the GLM-ANOVA program to study the relationships of the independent variables. Hypotheses were tested at the .05 alpha level.

Data about student attitudes toward technology were collected in order to determine if a relationship existed between the selected attribute variables. The variables included were gender, grade level, treatment or control, and geographic area. Student definitions of technology were collected in order to compare Mission 21 students to the control group. Students participating in the Mission 21 project represented the treatment group. The control group consisted of students enrolled at the same grade level and school as Mission 21 students, but not exposed to the Mission 21 project.

A reliability estimate was computed to determine the internal consistency of the Student Attitudes Toward Technology (SATT) Instrument for the population represented in this study. Cronbach's homogeneity coefficient alpha was used and a low degree of internal consistency was reported, r=.42. Post hoc however, two of the items had an extremely low correlation with the total alpha, thereby deflating the reliability.

There were 459 students in the treatment group and 399 students in the control group. The mean score for students in the treatment group was 19.38 ($\underline{s}$ = 2.54). The mean score for the control group was 22.28 ($\underline{s}$ = 3.31). For all means reported in this study, the lower the mean score, the more positive attitude towards technology.

The breakdown of subjects by gender was 412 boys and 446 girls. There were 205 boys and 254 girls in the treatment group. There were 207 boys and 192 girls in the control group. The mean score on the SATT instrument for boys in the treatment group was 19.78 (s = 2.78). The mean score for girls in the treatment group was 18.99 (s = 2.27). The mean score for boys in the control group was 23.12 (s = 3.50). The mean score for girls in the control group was 21.45 (s = 2.87).

The grade level of students was categorized as either third or fourth grade treatment or third and fourth grade control. Table 2 reports the means and standard deviations for the student attitudes toward technology scores for treatment/control, gender, gender by treatment/control, grade level, grade level by treatment control, and geographic area.

The treatment group consisted of 145 third grade students and 314 fourth grade students. The control group consisted of 231 third grade students and 168 fourth grade students. The mean score on the instrument for the third grade treatment group was 19.00 (s = 2.43) and the mean for the control group was 22.52 (s = 3.34). The mean score on the instrument for the fourth grade treatment group was 19.76 (s = 2.59) and the mean for the control group was 22.05 (s = 3.27).

The geographic location of students was categorized as either urban, suburban, or rural areas. For this study, each geographic area included two elementary schools for a

Table 2

Means and Standard Deviations for The Dependent Variable Attitude Toward Technology

Group	Number	Mean	Std. Deviation
Treatment Group	459	19.38	2.54
Control Group	399	22.28	3.31
Boys	412	21.45	3.47
Girls	446	20.22	2.75
Boys, Treatment Group	205	19.78	2.78
Girls, Treatment Group	254	18.99	2.27
Boys, Control Group	207	23.12	3.50
Girls, Control Group	192	21.45	2.87
Third Grade	376	20.76	3.34
Fourth Grade	482	20.90	3.04
3rd Grade, Trt. Group	145	19.00	2.43
4th Grade, Trt. Group	314	19.76	2.59
3rd Grade, Ctrl. Group	231	22.52	3.34
4th Grade, Ctrl. Group	168	22.05	3.27
Urban Area	221	20.57	2.86
Suburban Area	385	21.58	3.12
Rural Area	252	20.35	2.57

Note: The **lower** the mean score, the more positive attitude toward technology.

total of six schools. The overall mean score for the urban area was 20.57 (s = 2.86). The overall mean score for the suburban area was 21.58 (s = 3.12). The overall mean score for the rural area was 20.35 (s = 2.57).

Findings

Hypotheses 1 through 4 were tested for main effects. The main effects tested were gender (hypothesis 1), grade level (hypothesis 2), treatment or control (hypothesis 3), and geographic area (hypothesis 4).

Hypotheses 5 through 10 were tested for two-way interactions of the independent variables. Interactions tested were: gender by treatment or control group (hypothesis 5), gender by grade level (hypothesis 6), grade level by treatment or control (hypothesis 7), gender by geographic level (hypothesis 8), grade level by geographic area (hypothesis 9), and treatment or control by geographic area (hypothesis 10). Table 3 reports the ANOVA results for the main effects and 2-way interactions. The variance attributable to three and four-way interactions was included in the error variance and hypotheses related to these were not tested.

Table 3

Analysis of Variance Report

ANOVA Table for Response Variable:Attitude Toward Technology

Source of Variation	DF	Mean Square	F-Ratio	Prob>F	Effect Size
Main Effect					
GENDER	1	352.278	44.12	0.0000*	4.03%
TREATMENT/CONTROL	1	1252.657	156.90	0.0000*	14.33%
GRADE LEVEL	1	2.715	.34	0.5597	
GEOGRAPHIC AREA	2	92.161	11.54	0.0000*	2.11%
2-Way Interactions					
GENDER by TRT/CTRL	1	14.637	1.83	0.1757	
GENDER by GRADE	1	21.207	2.66	0.1031	
GRADE by TRT/CTRL	1	51.935	6.51	0.0108*	.60%
GENDER by GEOAREA	2	.922	0.12	0.8909	
GRADE by GEOAREA	2	17.747	2.22	0.1089	
TRT/CTRL by GEOAREA	2	15.125	1.89	0.1510	
ERROR	843	6730.225	7.98		
TOTAL(Adj)	857	8740.923			

GRADE = Grade Level
TRT/CTRL = Treatment/Control
GEOAREA = Geographic Area

*p<.05

Hypothesis 1: There is no difference in the attitudes of girls and boys toward technology. **Rejected.**

The calculated probability of the F value for the first hypothesis measured 0.0000 by the Number Cruncher Statistical System (NCSS), less than the 0.05 alpha level. The NCSS software only carries numerical values out to four decimal places. Therefore, the null hypothesis was rejected. Overall, girls had a more positive attitude towards technology than boys. The overall effect size for the variable gender was 4.03%.

Hypothesis 2: There is no difference between the treatment or control group attitudes toward technology. **Rejected.**

The ANOVA test for significant difference between the treatment group and the control group measured 0.0000, less than the a priori .05 level. The null hypothesis related to treatment/control was therefore rejected. The effect size for the variable treatment/control was 14.33%. This effect size was the largest of any main effect or interaction tested. Overall, Mission 21 students (treatment) had a more positive attitude towards technology than did students in the control group.

Hypothesis 3: There is no difference between third and fourth grade student attitudes toward technology. **Failed to Reject.**

Grade level was analyzed as a main effect by the GLM-ANOVA program, resulting in a non-significant difference (F=.5597, p=.05) between grade levels. Therefore, the null hypothesis failed to be rejected. Overall, there was no difference in student attitude towards technology between third and fourth graders.

Hypothesis 4: There is no difference between student attitudes toward technology in urban, suburban, and rural schools. **Rejected.**

The ANOVA statistical analysis detected a significant difference in geographic area between urban, suburban, and rural areas (F=0.0000, p=0.05). The null hypothesis was therefore rejected. The effect size for the main effect geographic area was 2.11%. There was a difference between the three means. However, using the statistical process set forth in chapter 3, it is unable to determine significantly where the difference between the means occurred at the 0.05 alpha level.

Hypothesis 5: There is no interaction of gender and treatment on attitudes toward technology. **Failed to Reject.**

The calculated probability of the F value for the fifth hypothesis was .1757. Therefore the null hypothesis failed to be rejected. There was not a significant interaction between gender and treatment or control groups on attitudes toward technology.

Hypothesis 6: There is no interaction between gender and grade level on attitudes toward technology.

Failed to Reject.

The calculated probability of the F value for the sixth hypothesis was .1031. Therefore, the null hypothesis failed to be rejected. There was not a significant interaction between gender and grade level on attitudes towards technology.

Hypothesis 7: There is no interaction between grade levels and treatment on attitudes toward technology.

Rejected.

The ANOVA test for significant difference between grade levels and treatment/control groups measured 0.0108 using NCSS software, less than the 0.05 alpha level. There was a significant interaction between grade levels and treatment/control groups on attitudes toward technology. Therefore, the null hypothesis related to grade level by treatment/control was rejected. The effect size for grade level by treatment/control was .60%.

The 2-way interaction graph in Table 4 displays a significant interaction between grade levels by treatment/control groups. The treatment (Mission 21) had more of an effect on third grade students than on fourth grade students. Thus, third grade students in the treatment group had a more positive attitude toward technology than

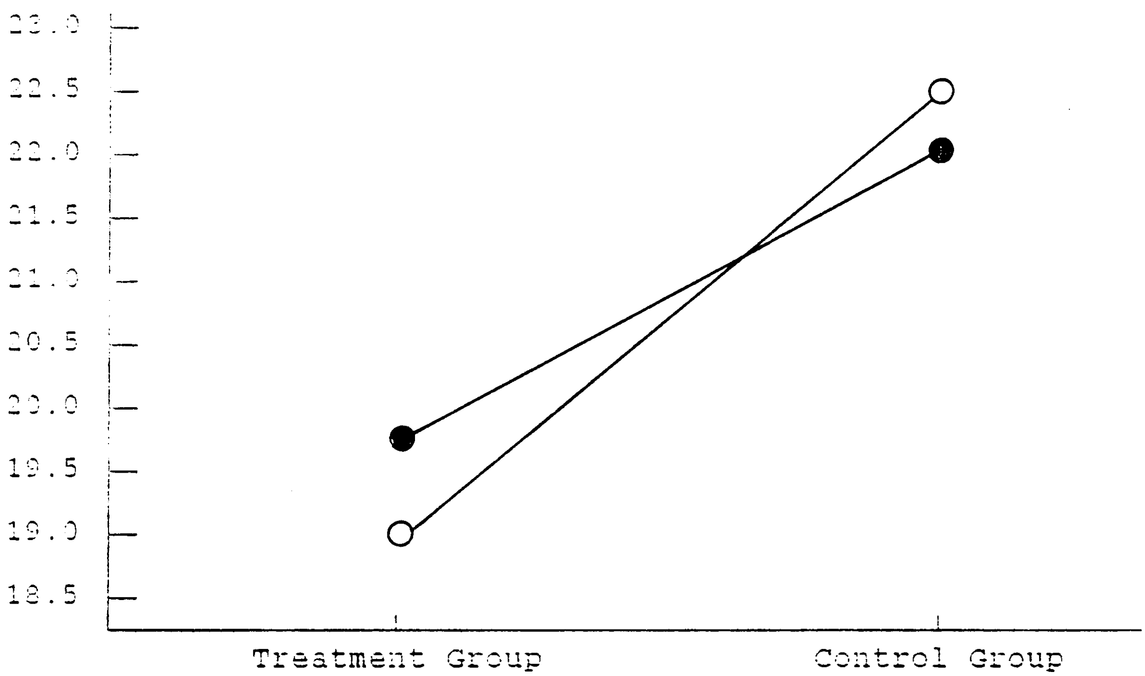
Table 4

2-way Interaction For The Cell Means
Grade Level by Treatment/Control Groups

	Treatment Group	Control Group
Third Grade	19.00	22.52
Fourth Grade	19.75	22.05

Graph for the 2-way Interaction of
Grade Level by Treatment/Control

Mean Score on
SATT Instrument



O = Third Grade, ● = Fourth Grade
Note: The **lower** the mean score, more positive attitude toward technology.

fourth grade students.

Hypothesis 8: There is no interaction between gender and geographic area on attitudes toward technology. **Failed to Reject.**

The calculated probability of the F value by the NCSS software program for the eighth hypothesis was .8909. Therefore the null hypothesis failed to be rejected. There was not a significant interaction between gender and geographic areas on attitudes toward technology.

Hypothesis 9: There is no interaction between grade levels and geographic areas on attitudes toward technology. **Failed to Reject.**

The calculated probability of the F value for the ninth hypothesis was .1089. Therefore the null hypothesis failed to be rejected because the F value was higher than the 0.05 alpha level used for testing all hypotheses. There is no difference in student attitudes towards technology between third or fourth grade students in urban, suburban, or rural schools.

Hypothesis 10: There is no interaction between treatment and geographic areas on attitudes toward technology. **Failed to Reject.**

The calculated probability of the F value for the final hypothesis tested was .1510. Therefore the null hypothesis failed to be rejected. A significant difference of student attitudes towards technology, tested at the 0.05 alpha level, could not be achieved for the treatment or control groups of students attending urban, suburban, or rural schools.

The third and fourth grade students in the treatment and control groups define technology in writing to address Research Question 1 (See Appendix 3).

Research Question 1: How do students who have experienced Mission 21 differ in their definitions of technology from those who were in the control group?

The Ethnograph Program (Seidel, Kjolseth, & Seymour, 1988) version 3.0 was utilized to categorize student definitions of technology from both the treatment and control group. The analysis of the definitions of technology from Mission 21 students are reported in Table 5. Definitions of technology from Mission 21 students in Table 5 are ranked from 1 to 24, including the frequency and percentage of each. A total of 471 definitions of technology were collected from students who participated in Mission 21.

The most frequent response reported from Mission 21 students was "technology solves problems" (75). The remaining top ten responses from Mission 21 students reported were "how things are made, formed, or improved" (54), "helps the world to be a better a place, cleans up

Table 5

Student Definitions of Technology From Mission 21 Students

Definitions of Technology	Frequency	Percent
1. Solves Problems.	75	15.93
2. How things are made, formed, or improved.	54	11.46
3. Helps the world to be a better place, cleans up pollution, saves nature.	43	9.14
4. Learn how to invent things.	39	8.28
5. Machines.	33	7.00
6. Application of Science.	33	7.00
7. Something you learn or good to learn about.	28	5.94
8. A lot of activities and fun.	25	5.32
9. Discover new things.	25	5.32
10. Helping people.	17	3.62
11. Use your imagination to brainstorm.	15	3.18
12. Putting an idea to work.	12	2.55
13. Helps me do things easier or better.	12	2.55
14. Adventure and knowledge.	9	1.90
15. Learning about computers.	9	1.90
16. I don't know.	7	1.49
17. Using electricity or electronics.	6	1.27
18. Tools or using tools.	5	1.06
19. Getting the most out of energy.	5	1.06
20. To be an innovator.	4	.85
21. Related to science.	3	.64
22. Group of systems.	2	.42
23. Communication devices.	2	.42
24. Other.	8	1.70
Totals	N=471	100.00%

Note: Other definitions of technology had a frequency of 1 and are listed in Appendix 4.

pollution, saves nature" (43), "learn how to invent things" (39), "machines" (33), "application of science" (33), "something you learn or good to learn about" (28), "a lot of activities and fun" (25), and "discover new things" (25). The "other" category of definitions of technology reported in Table 5 are listed in Appendix 4. These "other" definitions of technology had a frequency of one each.

Definitions of technology from students not exposed to Mission 21 (control group) are reported in Table 6. A total of 383 definitions of technology were collected. Student definitions of technology from the control group are reported in Table 6 and are ranked from 1 to 29, including the frequency, and percentage of each.

The most frequent response from the control group was "I don't know" (117). The remaining top ten responses reported from the control were "it's science" (33), "related to computers" (28), "electricity/electronics" (18), "machines" (17), "something you learn in college" (15), "your job or career" (13), "a smart person or being smart" (13), "what you think in your brain" (12), and "things about space, rockets, or moon" (9).

The "other" category of definitions of technology reported in Table 6 are listed in Appendix 5. These "other" definitions of technology had a frequency of one each.

Table 6

Student Definitions of Technology Not Exposed to Mission 21

Definitions of Technology	Frequency	Percent
1. I don't know.	117	30.55
2. Its science.	33	8.62
3. Related to computers.	28	7.31
4. Electricity/Electronics.	18	4.70
5. Machines.	17	4.44
6. Something you learn in college.	15	3.92
7. Your job or career.	13	3.39
8. A smart person or being smart.	13	3.39
9. What you think in your brain.	12	3.13
10. Things about space, rockets, or moon.	9	2.35
11. Something that makes things easier or better.	7	1.84
12. Something very hard to learn.	7	1.84
13. When you make or fix things.	6	1.57
14. Some subject like math.	6	1.57
15. Making things work or move.	5	1.31
16. To read, write, or spell correctly.	4	1.04
17. A better future.	4	1.04
18. When you learn about things.	3	.78
19. A better teacher, someone who teaches.	3	.78
20. Knowledge or wisdom.	2	.52
21. Power.	2	.52
22. Interesting.	2	.52
23. Something we should all learn about.	2	.52
24. The world.	2	.52
25. Interest idea or new idea.	2	.52
26. Fun.	2	.52
27. Important in life.	2	.52
28. Good for people	2	.52
29. Other.	45	11.75
Totals	N=383	100.00%

Note: Other definitions of technology had a frequency of 1 and are listed in Appendix 5.

Summary

This chapter presented the results of the factorial analysis of variance and definitions of technology for students participating in this study. A total of 858 Student Attitudes Toward Technology instruments were collected and analyzed. A total of 854 student definitions of technology were collected and analyzed.

Mission 21 students did have a more positive attitude towards technology than students in the control group (Alpha, 0.05). Overall, there was a significant difference between boys and girls attitudes toward technology. Girls had a more positive attitude towards technology than did boys. There was a significant difference in student attitudes toward technology between grade levels and treatment/control groups ($p<.05$). Overall, there was a significant difference between geographic areas.

The analysis of student definitions of technology from Mission 21 students found that "technology solves problems", was the most frequent response 15.93% (75). A total of 471 definitions were collected from Mission 21 students.

Student definitions of technology from the control group found that "I don't know" was the most frequent response 30.55% (117). A total of 383 definitions of technology from the control group were collected.

CHAPTER FIVE

Summary, Conclusions, Discussion and Recommendations

Chapter 5 is divided into four sections. The first section offers a summary of the problem, research methods, data analysis, and findings. In the second section the conclusions of the study are presented. The third section compares past research to this study and the final section provides recommendations for future research.

Review of the Problem, Research Methods, Data Analysis, and Findings.

Problem. The purpose of this study was to compare student attitudes toward technology and student definitions of technology from third and fourth grade Mission 21 students to a corresponding control group of students.

Population. The study sample consisted of 459 third and fourth grade Mission 21 students and 399 third and fourth grade control students. Six different Virginia elementary schools located in three separate geographic areas (urban, suburban, and rural) were analyzed in this study. There were 412 boys and 446 girls in the sample.

Research design and hypotheses. The research design used for the study was quasi-experimental using the posttest-only design with nonequivalent groups. The research methodology used for this study was a factorial analysis of variance. The study tested 10 hypotheses and one research question. Hypotheses 1 through 4 assessed the four main effects of the independent variables, gender, treatment/control, grade level, and geographic area. Hypotheses 5 through 10 tested for two-way interactions of the independent variables: gender by treatment/control, gender by grade level, grade level by treatment/control, gender by geographic area, grade level by geographic area and treatment/control by geographic area. The variance attributable to three and four-way interactions was included in the error variance and hypotheses related to these were not tested.

The research question compared student definitions of technology from students in the Mission 21 group (treatment) to students in the control group.

General procedures. Approval to conduct the research was obtained from either the building principal and/or local school board research personal. Meetings were held with the classroom teachers in the six schools involved in the study to go over testing procedures. Testing was conducted during the latter part of May and early part of June 1990.

Instrument. The instrument used for this study was a modified Pupils' Attitude Towards Technology instrument developed at Virginia Polytechnic Institute and State University. The instrument recorded student definitions of technology and student attitudes toward technology answers.

Analysis of data. Analysis procedures included the calculation of descriptive statistics to summarize characteristics of the study sample and analysis of variance to determine any statistically significant differences at the .05 alpha level. The Number Cruncher Statistical System (NCSS, Hintze, 1989) program was used to calculate the factorial ANOVA with unequal cell size. The Ethnograph Program (Seidel, Kjolseth, & Seymour, 1988), was utilized to categorize and provide frequencies for student definitions of technology from both the treatment and control group. Cronbach's homogeneity coefficient alpha was used to estimate reliability of the Student Attitudes Toward Technology (SATT) Instrument for the population of this study.

Findings. The findings are summarized as follows:

1. There was a significant difference in the main effect gender. Overall, girls had a more positive attitude towards technology than boys.

2. There was a significant difference in the main effect treatment/control. Mission 21 students had a significantly more positive attitude towards technology than students in the control group.

3. There was an overall significant difference in attitudes toward technology in the main effect geographic area.

4. There was no significant difference in the main effect grade level. Overall, there was no difference between third and fourth grade students attitudes toward technology measured at the 0.05 alpha level.

5. There was a significant difference in the 2-way interaction of grade level by treatment/control. The interaction indicated that the treatment (Mission 21), had a greater impact on third grade students attitudes toward technology than on fourth grade students.

6. There was no significant difference in the 2-way interactions of gender by treatment/control, gender by grade level, gender by geographic area, grade level by geographic area, and treatment/control by geographic area measured at the 0.05 alpha level.

7. The most frequent response reported from Mission 21 students to what technology means to me was, "technology solves problems". The next top three responses from Mission 21 students were, (2) How things are made, formed, or improved, (3) Helps the world to be a better place, cleans up pollution, saves nature, and (4) Learn how to invent things.

8. The most frequent response from the control group to what technology means to me was, "I don't know". The next top three responses from students in the control group were, (2) It's science, (3) Related to computers, and (4) Electricity/Electronics.

Conclusions

Based upon the findings in Chapter 4, the major conclusion of this study is that Mission 21 does in fact, improve student attitudes toward technology. Therefore, Mission 21 is a very promising technology education elementary school program that should be considered when integrating the study of technology into elementary school curriculum.

The second conclusion that can be drawn from the analysis in Chapter 4 is there is a significant difference in attitudes toward technology between boys and girls. The study found girls had a more positive attitudes towards technology than did boys. Girls had a more positive attitude towards technology in both the treatment and control groups. It's impossible to determine why girls in this study have a more positive attitude towards technology than boys.

The third conclusion that can be drawn from the analysis in Chapter 4 is the significant difference in attitudes toward technology between geographic areas. One can conclude that students in urban, suburban and rural schools do differ in their attitudes toward technology.

The fourth conclusion that can be drawn from the analysis in Chapter 4 is that a significant difference in attitudes toward technology occurs between grade level and treatment/control groups. Third grade Mission 21 students had a more positive attitude towards technology than did fourth grade Mission 21 students. One can conclude that a project like Mission 21, does have a greater impact on improving students attitudes toward technology on third grade students rather than on fourth grade students.

The fifth conclusion that can be drawn from the analysis in Chapter 4 is that students, overall, in either the third or fourth grade do not significantly differ in their attitudes towards technology. The researcher can only conclude that without third and fourth grade students being formally exposed to some formal technology and then measured, attitudes toward technology do not change.

The sixth conclusion that can be drawn from the analysis in Chapter 4 is that 2-way interactions consisting of gender by treatment or control group (hypothesis 5), gender by grade level (hypothesis 6), gender by geographic level (hypothesis 8), grade level by geographic area (hypothesis 9), and treatment or control by geographic area (hypothesis 10) produce no significant difference in student attitudes toward technology. One can conclude that these independent variables, working together, do not help explain the variance at the 0.05 alpha level.

The seventh conclusion that can be drawn from the analysis in Chapter 4 is the qualitative difference of student definitions of technology between the treatment (Mission 21) and control groups. The top three definitions of technology from Mission 21 students were: (1) Technology solves problems; (2) How things are made, formed, or improved; and (3) Helps the world to be a better place, cleans up the pollution, and saves nature. The top three definitions of technology from students in the control group were: (1) I don't know; (2) Its science; and (3) Related to computers. Overall, there was a vast qualitative difference between Mission 21 students definitions of technology when compared to students not exposed to Mission 21. One can conclude that Mission 21 students had a more comprehensive, insightful, and a better quality impression of technology than did students not exposed to Mission 21.

<u>Discussion</u>

It became apparent to the investigator, while visiting Mission 21 classrooms on a monthly basis (January to June, 1990), that a great deal of emphasis was placed on interdisciplinary education regarding the study of technology. If not for this emphasis, students would not have a clear, or accurate representation of technology in their world.

This study did not find a significant gender difference of student attitudes towards technology within the treatment or control group. However, overall there was a significant difference in the independent variable gender. This finding is consistent with research conducted by de Vries, Dugger, Bame, and Klerk de Wolters. What is not consistent with the findings with research conducted by de Vries, Dugger, Bame, and Klerk de Wolters is that, girls in this study, had a more positive attitude towards technology than boys.

de Vries's (1988) Virginia field-test work on the essay categories focusing on "what I think technology is" found "using tools/machines" the most frequent response. de Vries's work centered on middle school students exposed to formal technology education. His findings were not consistent with the student definitions of technology from third and fourth graders exposed to Mission 21. The most frequent response from students exposed to Mission 21 in this study was, "Technology Solves Problems".

The findings of this study are based upon the use of one specific instrument, chosen in part because of previous student attitudes toward technology research. The instrument was modified to reduce the reading level so students could comprehend statements about technology. Also, the number of items was reduced from 100 to 20, due to the attention span of students at the third and fourth grade. It may be possible that another instrument would have assessed the variables of this study in a more accurate manner, especially in light of the low reliability of the Student Attitudes Toward Technology (SATT) Instrument as calculated for this study sample.

It is important to note that Mission 21 student definitions of technology had a more global and comprehensive approach to understanding technology than did students in the control group. Qualitative explanation in the analysis used The Ethnograph Program to help categorize student definitions of technology from both students in Mission 21 (treatment) and control group. The Ethnograph Program also allowed quantitative measurement to determine the frequency of student definitions of technology. For example, the top four definitions of technology from Mission 21 students (ranked in order) were: (1) Solves problems, (2) How things are made, formed, or improved, (3) Helps the world to be a better place, cleans up pollution, saves nature, and (4) Learn how to invent things. The top four definitions of technology from students in the control group (ranked in order) were: (1) I don't know, (2) Its science, (3) Related to computers, and (4) Electricity/Electronics. Granted, the second, third, and fourth definitions of technology from students in the control group are specific aspects of technology, however, they are very focused.

Recommendations

This study was confined to third and fourth grade students in six elementary schools in the Commonwealth of Virginia located in urban, suburban, and rural areas.

1. The present study was conducted only among third and fourth grade students. It is recommended that in future research, both first and second, and fifth and sixth grade students participate in this research to determine if there are any differences in grade level and what effects, if any, these differences produce.

2. Since the present study did not attempt to look at differences outside Virginia, it is not known whether or not there is a difference between technology education

elementary students in other states. It is therefore recommended that future research should investigate differences which may be attribute to differences in student attitudes toward technology in other states.

3. Characteristics of student attitudes toward technology have been attributed to gender difference. The extent to which those characteristics existed in the study for girls having a more positive attitude toward technology than boys in this sample is not known. It is recommended that in future research, girls and boys in other elementary grades be identified to see what effect Mission 21 has on attitudes toward technology between genders.

4. The present study, as well as previous research, indicated that measurement of student attitudes toward technology is an ongoing question. It is recommended that further research in measurement and instrument construction of student attitudes toward technology be conducted.

5. Since differences between geographic areas were found in this study, it may be possible that these students differ in other grade levels in different geographic areas. It is recommended that future student attitudes toward technology research be conducted at different grade levels comparing geographic difference.

6. The present study did find a treatment effect for students having a more positive attitude towards technology

than students in the control group. It is recommended that further research be conducted in other technology education elementary school programs to determine any differences in technology activities and what effects in student attitudes toward technology, if any, these program differences produce.

7. It is recommended that a longitudinal study be performed in the future to determine if any differences exist over time in student attitudes toward technology between gender, grade levels, different geographic areas and between treatment/control groups because the impact of technology continues to effect all groups of people.

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Appendix 1

Letter of Permission

April 30, 1990

Principal
Elementary School
Street
City, State Zip Code

Dear Principal:

The purpose of this letter is to request your permission to administer the enclosed Student Attitudes Toward Technology Instrument. Would it be possible on the morning of Wednesday, May 9, 1990 to administer this instrument with Mission 21 students and other third and fourth grade students not exposed to Mission 21 at your school? The instrument would take approximately 15 minutes to administer. The instrument would not be a waste of your students valuable learning time. They would be practicing their reading skills, improving their vocabulary, and enhancing their test taking ability.

The purpose of this instrument is to determine Student Attitudes Toward Technology. The data collected **will not** be tracked back to individual schools, teachers, or students. Data collected from all schools will be classified buy: (1) Urban, Suburban, or Rural school setting, (2) Third or Fourth grade, (3) Students exposed to Mission 21 or not, and (4) Gender only.

This instrument will be given to over 800 third and fourth grade students in Virginia. Over one-half of these students have been exposed to technology education through the Mission 21 project. The remaining students will be students at the same grade levels and enrolled at the same school not exposed to Mission 21.

Thank you Mrs. Principal for your time and cooperation. I will be calling you either Thursday or Friday of this week (4/30/90) to discuss the administering of the instrument with your teachers.

Sincerest Regards,

Duane D. Dunlap
NASA/Virginia Tech Research Associate

Appendix 2

Third and Fourth Grade Mission 21 Design Briefs

Machines Theme

A Room Full of Machines
Mapping Great Machines
Lunar Mover
Transformers
Trees To Paper
Invasion Of The Noids
Probing The Future

Discovery Theme

Switch On
Communicator
Space Station Alpha Calling
Solar Magic
Creation Innovation

Community Theme

Technology Sound Check
Earth Town 2001
Safe Water
On The Wings of Man
Technology Makes It Happen
Turning Trash Into Treasure

Connections Theme

Earth Is My Home
Technology To The Rescue
I've Been Working On The Line
A Better You
Space Frontier
Times Sure Have Changed

Appendix 3

Instrument

INSTRUCTIONS TO THE TEACHER FOR ADMINISTERING THE STUDENT ATTITUDES TOWARD TECHNOLOGY QUESTIONNAIRE

1. Give a brief introduction to the questionnaire. Tell the students that this questionnaire is administered for research purposes and that it is about their opinion of technology. Students should be assured that their answers will be analyzed anonymously. Students do not have to give their names. Emphasize that this is not a test. However, do mention that their answers are important and the questionnaire should be taken seriously. There are no right or wrong answers. Students should give their own opinion.

2. Read the instructions on the instrument to the students. Explain the instructions if necessary. Do not define technology for them. We are interested in what they think technology is. Students may use either pen or pencil to take the questionnaire.

3. First, pass out page one of the instrument <u>only</u>. (Do <u>NOT</u> pass out page 2 yet). Have them write what they think technology is. This should be done individually. Have students circle the correct answers in questions one through three. If your students participated in Mission 21 have them circle YES in question three. If your students did not participate in Mission 21, students circle NO to question three. Students may use the entire box to write what they think technology is. Strongly encourage students to write what they think technology is. After the students have completed writing what they think technology is, collect their definitions.

4. Once you have collected all their ideas of what they think technology is, pass out the **Student Attitudes Toward Technology** questionnaire (page 2). Reread the instructions to the students. The first three questions pertain to demographic information only. Have students circle the appropriate answer. Have students write their age in the blank next to question 3.

5. For the remaining statements, students circle only a YES or NO response. Stress that they should read each question carefully. You may read the statements to them. However, do not define technology for them. As the students take the instrument, walk around the classroom and make sure they are circling in the correct portion of the instrument and their response is either a YES or NO. The instrument should take approximately 15 minutes to complete. Remember, students are to work individually. When students are finished, collect the instruments and put them in the brown envelope along with their descriptions of technology.

6. **Thank You for your time and cooperation!!**

Student Attitudes Toward Technology

We are interested in what you think about technology.
This is not a test.
You will not be graded on it.
Circle the answers to the following questions.

1. Are you a Boy or Girl? ------------------------------------ Boy Girl

2. Are you in the 3rd or 4th grade? -------------------------- 3rd 4th

3. I have worked on Mission 21 activities -------------------- YES NO

Think about technology.
Write down what technology means to you.
Just give your own idea.
Write on the lines in the box below.

Student Attitudes Toward Technology

We are interested in what you think about technology.
This is not a test.
You will not be graded on it.
Read each sentence carefully.
Circle **YES** if you agree with it.
Circle **NO** if you do not agree with it.

EXAMPLE: I like pizza. ------------------------------------ (YES) NO

---

1. Are you a Boy or Girl? ------------------------------------ Boy Girl
2. Are you in the 3rd or 4th grade? -------------------------- 3rd 4th
3. How old are you? _______.
4. Technology is good for this country. ---------------------- YES NO
5. Technology makes things work better. ---------------------- YES NO
6. I would rather study something else instead of technology. - YES NO
7. I like to read about technology. -------------------------- YES NO
8. Technology affects the way I live. ------------------------ YES NO

Turn this page over and complete the rest of your answers

9. There should be <u>fewer</u> TV shows about technology. ----------- YES NO

10. Boys are able to work with their hands better than girls. -- YES NO

11. I like to learn about technology at school. ---------------- YES NO

12. Girls are able to use or run a computer. ------------------- YES NO

13. Boys know more about technology than girls do. ------------- YES NO

14. I should be able to take technology as a school subject. --- YES NO

15. I think everybody should learn about technology. ----------- YES NO

16. People need technology. ------------------------------------ YES NO

17. Technology makes our world a better place. ----------------- YES NO

18. I want to learn more about technology. --------------------- YES NO

19. Technology solves problems. ------------------------------- YES NO

20. I think machines are boring. ------------------------------- YES NO

Thanks For Your Help!

Appendix 4

Other Student Definitions of Technology
From Mission 21 Students

Definitions of Technology	Frequency	Percent
Progress.	1	.21
Getting a job.	1	.21
Work with technical things.	1	.21
The study of industrial arts.	1	.21
Helping me to be safe.	1	.21
Welding.	1	.21
Drawing and building.	1	.21
Something you do around school or home.	1	.21
N= 8		1.70%

Appendix 5

Other Student Definitions of Technology Not Exposed to Mission 21

Definitions of Technology	Frequency	Percent
New creations.	1	.26
To lean about other places.	1	.26
Finding out about stuff.	1	.26
Research.	1	.26
Skills.	1	.26
To follow directions.	1	.26
Solve problems.	1	.26
Its everything.	1	.26
Something that helps people	1	.26
It means to think.	1	.26
To get something right.	1	.26
Energy.	1	.26
How animals and people live.	1	.26
Exploring things.	1	.26
Something you test.	1	.26
How smart a company is.	1	.26
When you try to do your best.	1	.26
Something your good at.	1	.26
Health.	1	.26
Manmade things.	1	.26
Working with things.	1	.26
People who work in factories.	1	.26
Bureaucracy.	1	.26
Getting things to work faster.	1	.26
Reading a questions.	1	.26
Going to a higher grade.	1	.26
Working with each other.	1	.26
Doing experiments.	1	.26
History.	1	.26
Discovery.	1	.26
Drugs in drinks and medicines.	1	.26
How things grow.	1	.26
Living things.	1	.26
Inventions.	1	.26
Things from the past.	1	.26
Someone that can do something better.	1	.26
Tools.	1	.26
Responsibility.	1	.26
Engineering.	1	.26
Something that is very hard.	1	.26
When some is sick.	1	.26

Appendix 5 continued:

Weather.	1	.26
How you feel about school.	1	.26
Student attitudes.	1	.26
Sea Creatures.	1	.26
N=45		11.75%

Curriculum Vitae

Duane D. Dunlap

EDUCATION:

Master of Science, Industrial and Technical Education, Louisiana State University, Baton Rouge, Louisiana. December, 1985. *[Thesis Option].

Bachelor of Science, Industrial Technology Education, The Ohio State University, Columbus, Ohio. June, 1982.

EXPERIENCE:

Research Associate, NASA/Virginia Tech. Employed under NASA's Graduate Student Researchers Fellowship Program. August 1988 - August 1990.

Faculty member with teaching and research emphasis in Technology Education and Computer-Integrated Manufacturing. Department of Industrial Technology, Southeastern Louisiana University, Hammond, Louisiana. August 1985 - May 1988.

COURSES TAUGHT: Electronics, Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Industrial Robotics, and Microcomputer Hardware and Interfacing, and Computer-Integrated Manufacturing (CIM).

Technology Education Teacher in Electronics and Robotics, St. Amant High School,St. Amant, Louisiana. August 1982 - June 1985.

Consulted with numerous businesses and industries while on staff at Southeastern Louisiana University.

RESEARCH AND GRANT ACTIVITIES:

NASA's Graduate Student Researchers Program, NASA Headquarters, Washington, D.C. Funded for 24 months to develop and field-test technology education curriculum materials (Mission 21). August 1988-89, $36,000.00.

Funded by a Teaching Enhancement Grant for Data Manipulation of Robotic Control by Southeastern Louisiana University Development Foundation. April 1988, $300.00.

Certanium Alloys & Research Company, Cleveland, Ohio. Industrial consultation involving welding robots in a R&D laboratory using certanium electrodes. March 1988.

Project Director - Program Expansion, Improvement, and Innovation for computer-aided manufacturing equipment. Funded by the Carl D. Perkins Vocational Act of 1984 (P.L. 98 - 524). January 1988, $1,950.00.

Bass Electronics, Inc. Baton Rouge, Louisiana. Feasibility Study for Georgia Pacific involving the development of a Gantry Robot for Plywood Gluing Operations. June 1987.

Multi-Robot Work Cell Development Project, Southwest Computer Systems Corporation, Dallas, Texas. February - May 1987.

Wrote and proposed a Teaching Enhancement Grant to participate with students in the 1987 International Student Robot Contest, sponsored by the Society of Manufacturing Engineers. It was funded by Southeastern Louisiana University Development Foundation. March 1987, $500.00.

Project Director - Sex Equity Guide for Technology Education in Louisiana. Funded by the Carl D. Perkins Vocational Education Act of 1984 (P.L. 98 - 524). January 1987, $12,721.00.

Project Director - Microprocessor and Robotics Curriculum Guide. Funded by the Carl D. Perkins Vocational Education Act of 1984 (P.L. 98 - 524). January 1986, $13,500.00.

Hardware and Software Interface of an 80286 microprocessor based computer to a Cincinnati Milacron T3-364 Industrial Robot. Zenith Data Systems. Benton Harbor, Michigan. August - December 1986, $3,800.00.

Project Director - Program Expansion, Improvement, and Innovation for CAD equipment. Funded by the Carl D. Perkins Vocational Act of 1984 (P.L. 98 - 524). November 1986, $9,113.00.

Wrote and proposed a CAD software grant which was accepted by Micro Control Systems, Inc., for CADKEY 3-D software. Vernon, Connecticut. October 1986, $2,695.00.

Wrote and proposed a Teaching Enhancement Project for the Development of Creative Management Skills Involving Industrial Technology Students. Funded by Southeastern Louisiana Development Foundation. March 1986, $200.00.

Project Director - Program Expansion, Improvement, and Innovation for six different robotic work cells. Funded by the Carl D. Perkins Vocational Act of 1984 (P.L. 98 - 524). November 1985, $8,325.00.

Wrote and proposed an exemplary project which was accepted and funded in the area of Robotics for Technology Education at St. Amant High School, St. Amant, Louisiana. Louisiana Board of Secondary and Elementary Education. April 1984, $20,000.00.

PUBLICATIONS:

"Curriculum Development For Robotics Instruction", Technological Horizons In Education, Spring 1990, [Refereed].

"Launching Technology Education Into The Elementary Classroom", The Technology Teacher, December 1988, Vol.43, No.3, [Refereed].

"Structuring Robotics Curriculum for Secondary and University Technology Education Programs", Robotics For Educators, Society of Manufacturing Engineers. October 1987.

Sex Equity Handbook for Technology Education in Louisiana, Office of Vocational Education, Louisiana State Department of Education. October 1987.

"TECHNOLOGY EDUCATION: Perspective and Direction for Louisiana Industrial Arts Programs", LIAISON. March 1987.

"Robotics Implementation In Industrial Arts/Technology Teacher Education Programs In The Continental United States", Journal of Technology and Society, Winter, 1987 Vol.1, Issue 1. [Refereed].

"The Price of Professionalism", LIAISON. March 1987.

Microprocessors and Robotics, Curriculum Guide for the Louisiana State Department of Education. February 1987.

"Using The Rhino XR-2 Robot to Weld", LIAISON. May 1986.

* Thesis, Robotics Implementation In Industrial Arts/Technology Teacher Education Programs In The Continental United States, Copyright February 1986.

"Rhino IBM PC Courseware", Reviewed and Edited for Rhino Robots Inc., January 1986.

Computer Literacy, Curriculum Guide for the Louisiana State Department of Education. March 1985.

Basic Electronics, Curriculum Guide for the Louisiana State Department of Education. October 1984.

"Implementing High Technology Into The Curriculum", LIAISON. October 1983.

Between 1985-88, I reviewed textbooks and manuscripts for Delmar Publishers and Merrill Publishing Company in the area of electronics and robotics.

PRESENTATIONS:

Numerous Mission 21 Teacher Inservices around the Commonwealth of Virginia and at NASA, ITEA, and STS functions. November 1988 - June 1990.

"Computer-Integrated Manufacturing", Gulf Regional Interstate Collegiate Consortium, Southeastern Louisiana University, April 1988.

"Robotics - Blue and White Collar ReEducation", Keynote Dinner Speaker, Louisiana Data Processing Management Association, Baton Rouge Hilton, November 1987.

"Teaching Leadership Skills Through Problem Solving", Keynote Speaker, Louisiana Industrial Arts Student Association Leadership Conference, Bunkie, LA. October 1987.

"Curriculum Development", Robotics for Educators, Society of Manufacturing Engineers, Gaithersburg, Maryland. October 1987.

"Using Robotics To Teach Math and Science Concepts to Elementary Students", Norfolk and Hampton Roads Public Elementary School Teachers, NASA Langley Research Center, Hampton, Virginia. August 1987.

"Using Robotics In Student Competitive Events", American Industrial Arts Student Association National Conference, Baton Rouge, Louisiana. June 1987.

"Applying Robotics In Education", Louisiana Computer Using Educators, Baton Rouge, Louisiana. November 1987.

"The Pride of Success", First General Session, 28th Annual Louisiana Industrial Arts Student Association State Conference, Baton Rouge, Louisiana. May 1986.

"Pride That Comes Within", Denham Springs High School Industrial Arts Student Project Fair, Denham Springs, Louisiana. April 1986.

"Robotics Implementation In Industrial Arts/Technology Teacher Education Programs In The Continental United States", International Technology Education Association, Kansas City, Missouri. March 1986.

"Robotics Programming", High Technology Teacher Inservice Training, Sponsored by the Louisiana State Department of Education. Louisiana State University and Southeastern Louisiana University. Summer 1985.

"Robotics: Applications For Technology Education", American Vocational Association Conference, New Orleans, Louisiana. December 1984.

PRESENTATIONS: (continued)

"Implementing Robotics into the Technology Education Laboratory", Louisiana Vocational Education Supervisors, New Orleans, Louisiana. December 1984.

"Increasing Student Enrollments in Technology Education", American Vocational Association Conference, New Orleans, Louisiana. December 1984.

"Robotics: An Introduction to Their Classroom Use", Louisiana Vocational Association Conference, Shreveport, Louisiana. August 1984.

STUDENT ORGANIZATION ADVISOR ACTIVITIES:

National Association of Industrial Technology Chapter Advisor, Department of Industrial Technology, Southeastern Louisiana University. August 1985 to May 1988.

American Industrial Arts Student Association Chapter Advisor, St. Amant High School 1982 - 1985. Second Most Outstanding AIASA Chapter 1984, Third Most Outstanding AIASA Chapter 1983, and Third Place AIASA Chapter Record Book 1983.

Louisiana Industrial Arts Student Association Chapter Advisor, Most Outstanding LIASA Chapter for 1985, Second Most Outstanding LIASA Chapter 1983 and 1984, and Second Place LIASA Chapter Record Book 1983 and 1984.

UNIVERSITY AND PROFESSIONAL ACTIVITIES/MEMBERSHIPS:

Ascension Teachers of Industrial and Agriculture Education, President, 1983-1984.

Board Member on the Ascension Parish Advisory Council for Secondary Vocational Education, 1984-1985.

College of Science and Technology Honors Convocation Committee, August 1985 - May 1988, College Curriculum Committee, August 1987 - May 1988, Teacher Education Curriculum Council August 1986 - August 1987, Southeastern Louisiana University.

Council On Technology Teacher Education, 1985 - Present.

* Departmental Committee Chair(s) Research and Grants, August 1987 - May 1988 and Electronics/Automated Systems, August 1985 - May 1988.

Epsilon Pi Tau Fraternity - Alpha Chapter, 1982 - Present.

UNIVERSITY & PROFESSIONAL ACTIVITIES/MEMBERSHIPS: (continued)

International Technology Education Association, 1982 - Present.

Louisiana ITEA Voting Delegate - 1984, 1986, 1987, and 1988.

Louisiana ITEA Affiliate Representative 1986-88.

Louisiana Technology Education Association Past President, 1986-87; President, 1985-86; President-Elect, 1984-85; and Secretary, 1983-84.

Louisiana Industrial Arts Student Association Advisory Council. 1982-85.

Louisiana Vocational Association 1st Vice-President, 1986-87.

Louisiana Vocational Association Executive Council, 1984-87.

Society of Manufacturing Engineers and Robotics International, Senior Member, 1987 - Present.

Technology Education for Children Council 1988 - Present.

AWARDS:

Director of the Southeastern Robotics Research Development Team, Placing 2nd in the World during the ROBOTS 11 Student Robots Contest, Sponsored by SME/RI in Chicago, Illinois. April 1987.

The United States Department of Education Secretary's Outstanding Vocational Education Program Award for Advanced Electronic Robotics in Technology Education, April 1986.

Outstanding Louisiana Industrial Arts Student Association Chapter Advisor, May 1985.

Outstanding Young Men of America, November 1984.

Outstanding Student Award, Department of Industrial Technology Education, The Ohio State University, June 1982.

PERSONAL:

-Born June 26, 1959 in Canton, Ohio
-Married to Elizabeth Ann Calio
-Elizabeth has been teaching elementary school for the past 9 years
-One child, Charlotte Marie (7 months old)

July 1990