The role of technology education in selected Iowa elementary schools

by

Alfred A. Hart III

A Thesis Submitted to the

Graduate Faculty in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

Major: Industrial Education and Technology
(Industrial Vocational-Technical Education)

Approved:

Signatures have been redacted for privacy

Iowa State University
Ames, Iowa

1992

TABLE OF CONTENTS

CHAPTER I. INTRODUCTION

During the 1980s, U. S. education came under severe attack, with good reason. There were 25 million American who could not read or write (Zuckerman, 1989). An additional 45 million were functionally illiterate; they could not read or write well enough to find work or complete a job application. That number was said to be growing by more than two million a year. The need to provide all elementary and high school students with a better understanding of mathematics, science, languages, and technology is critical. The use of computers and technology in the schools, however, requires more than reading and writing skills; it requires early exposure to key concepts of science and technology, beginning at the grade school level for all students. The need for early and frequent exposure to scientific and technical concepts is especially critical for students at risk or for those who may ultimately wind up in the vocational (rather than college preparatory) curriculum in high school.

The National Commission on Excellence in Education (1983) expressed that K-12 instruction in mathematics, science, and technology, must be strengthened. The committee believes that the educational process must include an additional element, a bridge from science and math for the development and use of technology. Literacy today demands that the individual understand basic concepts of technology. This is a necessity. Edward A. Friedman (1980) states that:

> Educated persons must gain an understanding of engineering concepts and techniques if they are to actually participate in future decision making. Without this knowledge they will be unable to make informed decisions on such varied issues as urban planning, energy policies, and satellite communications (p. 8).

It is possible that the majority of our population may be more illiterate in the technical sense than they are in the historical or geographical senses.

The House of Representatives (1986) cited from The National Geographic Foundation that:

> Technological literacy needs to be a part of general literacy--In a sense we are speaking of "basics" in education, and we are identifying the knowledge and understanding of technology as "basic" (p. 25).

The House of Representatives (1986) also stated from the Carnegie Foundation that:

> We recommend that all students study technology: the history of man's use of tools, how science and technology have joined, and the ethical and social issues technology has raised (p. 25).

Statement of the Problem

This study was designed to investigate the technology education programs in selected elementary schools in Iowa. It is not intended to evaluate the programs, only to determine what the students are learning.

Purpose of the Study

The purpose of this study was to identify, by means of a survey what specific activities are being utilized, infused, and what students are learning about technology education, in selected elementary schools in Iowa.

Need for the Study

The understanding of opportunities presented by new technologies is critical to education in our society. It is necessary to understand the functions to which new technologies can be applied and the principles underlying these applications.

The elementary school technology curriculum should be designed to develop the recognition or awareness of technology and its effects on the individual in society and the environment. It should also develop the realization of one's self in order to help the child gain an identity and recognize his or her talents and abilities.

In his article, Technology in the Elementary School, Hicken (1982) pointed out that specific programs for implementing the study of technology in the elementary school are limited. Evidence in the research and literature indicates the need for technology-oriented studies for students in the elementary grades. The elementary school technology curriculum is designed to develop a broad understanding of technology and to meet the following curriculum goals:

1. The development of technological literacy.
2. The development of consumer skills.

3. The encouragement and support of recreational skills.
4. The facilitation of cultural efficiency within the technological domain of our culture.
5. The development of occupational awareness.
6. The development of values to assess the appropriate use of our technology and resources.
7. The development of a time perspective continuum; the effect of past ways of doing things and future and current ways of doing things (p. 22).

Hoots (1980) wrote that teachers of elementary industrial education must have a fundamental knowledge of the technology from which the content of industrial education is derived. This content needs to be thoroughly investigated in terms of what is appropriate for each grade level; how it can best be integrated into the curriculum of that particular grade; and what manipulative activity will best promote learning experiences. In this same article, Hoots stated that:

> The average citizen cannot completely comprehend the transformation. The age in which we live is one of such rapid change that even those who cause and control the change are frightened by its implementation. Children must learn about the world in which they live if they are to be productive and useful citizens in the world of tomorrow (ACESIA Monograph 8).

Questions of the Study

1. What clusters of technology education are being incorporated in the elementary classroom?

2. Does the elementary teacher incorporate the clusters of technology within the elementary education curriculum?
3. What problems or barriers exist which inhibit the elementary teacher to include the principles of technology?
4. Are the materials that are made available being utilized to help infuse technology principles in elementary education courses?

Assumptions of the Study

The following assumptions are made concerning this study.

1. The procedure for selecting the research instrument was valid and adequate.
2. That the elementary teachers in selected elementary schools in Iowa participated in the Industrial Arts & Career Education Workshops in the summers of 1980-1981.
3. The elementary teaches are incorporating technology education in their classrooms.
4. The technology education programs or activities supplement other curriculum areas of elementary education.

Delimitations of the Study

The following limitations are made in order to conduct the study.

1. The study will concern itself with selected elementary schools in Iowa.
2. The study is limited to teachers who participated in Industrial

Arts and Career Education Workshops in the summers of 1980-1981.

3. The survey instrument for the study is limited based on the respondents answers and adequacy of information requested.

Procedure of the Study

The following procedure was used to conduct the study.

1. Reviewed the literature in order to identify the parameters of the research study.
2. Developed research questions and purposes for the study and present the research proposal to the program committee for approval.
3. Made proposal revisions.
4. Developed survey instrument.
5. Modified survey instrument and made it appropriate for the researcher's study.
6. Mailed survey to selected sample.
7. Collected and analyzed data.
8. Drew conclusions based on data collected.
9. Made recommendations from obtained results.
10. Presented the final research study to the program committee for final examination.

Definition of Terms

1. **Illiteracy**--As defined by The Merriam/Webster Dictionary (1988) the lack of education or culture; inability to read or write.

2. **Literacy**--The ability to read, write, and compute with the functional competence needed for meeting the requirements of adult living.
3. **Technology**--Technology is a social process that employs scientifically and empirically based tools, techniques, knowledge, resources, and systems to affect the human environment and its organizations (Splete, 1986).
4. **Technology Education**--A program concerned with technical means; their evolution, utilization, and significance with the industrial system, products, and their social/culture impact (Iowa Curriculum Assistance System, 1986).
5. **Career Education**--The training of the mind to encounter the successful pursuit of one's lifework.

CHAPTER II: REVIEW OF THE LITERATURE

An attempt was made, throughout the review of the literature, to investigate articles and research related to industrial education and technology. This review of literature was undertaken to score the importance and need for this research. This review was documented in five sections: historical review, educational reform, technology literacy, rationale for technology education, and elementary school technology education program.

Historical Review

This section of the review of the literature presents research and writings which are relative to industrial education and technology for the elementary school. This information is presented as a historical review.

Industrial arts for the elementary school had its beginnings in the United States under the auspices of manual training. Manual training began to flourish as an educational program during the 19th century. These programs were influenced by the writings of such educators as Rousseau, Pestalozzi, Herbart, and Froebal (Keller, p. 12, 1978). The influence of distinguished educators such as the American John Dewey has combined with the popularization of psychoanalytic ideas to make American education substantially more child centered than it used to be. In addition, the gradual accumulation of knowledge about the different ways in which children learn and about the special needs of many children have led the elementary education system to be more sensitive to identifying and attending to individual differences (Funk and Wagnalls, p. 69, 1986).

Dewey's book, The Child and the Curriculum (1902), emphasized that:

> Let the child's nature fulfill its own destiny, revealed to you in whatever of science, art, and industry the world now holds as its own (p. 39-40).

A. N. Whitehead, in his article "The Aims of Education" (1959), states:

> Let the main ideas which are introduced into a child's education be few and important and let them be thrown into every combination possible. The child should make them his own and should understand their application (p. 14).

John Dewey's emergence as an educational leader and teacher supported and motivated educational reform in elementary schools. Dewey (1915) stated that:

> The child who is interested in the way in which men lived, the tools they had to do with, the new invention they made, the transformations of life that arose from the power and leisure thus gained, is eager to repeat like processes in his own action, to remake utensils, to reproduce processes, to rehandle materials (p. 158).

There were also others who made an astonishing impact toward the foundation and the role in establishing a technology education program in the elementary schools. Frederick S. Bonser, who has been credited as the "father" of industrial arts in the elementary school and Elizabeth Hunt, who in 1962 chartered a group which was to become the American Council for Elementary School Industrial Arts.

Technology education in the elementary school has a relatively short history. However, that history is founded upon the theories of recognized and authoritative educators.

Educational Reform

Science and technology are the foundations of modern civilization. New discoveries are being made and new technologies are being integrated into the average person's day to day life. As we make new demands in science and technology, science and technology are making new demands on us.

We must recognize that science and technology are integral parts of today's society and these are essential elements for consideration throughout the K-12 curriculum. Students must be educated in the scientific and technological approach to the solutions of everyday problems.

A report from The National Center for Improving Science Education (NCFISE, 1989) stated that:

> The standards for technical and scientific literacy that the work force must meet are becoming more stringent, not less. Clearly, most Americans can learn about science and technology, if they are to compete in the global marketplace and exploit their personal potential to the fullest, they must learn about science and technology (p. 12).

Compared to Lamar Alexander, Norman Schwarzkopf had it easy. Alexander, newly sworn in as Secretary of Education for U.S. schools, faces a task that has frustrated generations of reformers improving our U.S. school system. Chira (1991) said that making America an educational as well as a military superpower will mean confronting several crises:

1. The glaring failure of the worst students.

2. The tolerance of mediocrity.

3. A national heritage of anti-intellectualism.

It will mean combating poverty disintegrating families. It will require grueling work from students and an end to parental apathy (p. 1C). According to Stern:

> Technology education is a bright new hope in curriculum reform. It provides school children with important content and contextual information about technology, while using successful teaching methods which emphasize integrated, holistic, multidisciplinary, multisensory, hands-on learning (p. 3).

Janey (1989) also said that:

> The ultimate goal of school reform is to improve the quality of teaching and learning in classrooms which serve students who possess a variety of needs and abilities. To achieve this goal, school reform must be programmatically relevant and politically acceptable to parents, teachers, and administrators (p. 32).

Additional support for curriculum reform came from Tyler (1990) who responded that:

> Actual improvements in curriculum and instruction depend on the actions of teachers and parents. Reforms which persist over time are those which are understood and believed to be important by teachers and parents in the local school and in which teachers have gained the skills these reforms require (p. 24).

Lewis (1989), former executive editor of Education U. S. A. stated that:

> We have a box full of tools but no blueprints, in order words; we have tools to make reform but we have no consistent goals (p. 180).

Crim (1990) mentions a few challenges that we can meet and identify by our schools:

1. The need for schools to prepare students for work.
2. An increasing dependence on and a need to understand technology.
3. Early childhood education.
4. Higher standards of literacy (p. 24).

The often quoted 1983 "Nation at Risk" National Commission on Excellence in Education report; which launched a reform movement; causing our nation to begin a great debate about the quality--and, ultimately, the equality of public education. It touched all the bases:

1. Illiteracy.
2. The decline in graduation standards and in student's mastery of basic skills.
3. Science and technology (Futrell, 1989, p. 10).

In the words of Bill Strange, a staff member with the Indiana Department of Public Instruction, "Americans need to learn to value academic learning as much as we have come to appreciate a good slam dunk" (Evans, 1983, p. 1976).

The launching of Sputnik in 1957 set off a series of educational reforms in the U.S. that yielded new instructional materials in mathematics, the sciences, and language, all strongly focused on process rather than product. However, aside from providing a temporary mental boost for some teachers, these materials had little impact on the learning of U.S. school children.

Evans (1983) also mentions that there were three major problems:

1. The gap between the level of teacher proficiency that these materials required.
2. The reality of the average teacher's skills.
3. The materials were also perceived as too difficult for many students (p. 176).

In addition to emphasizing the basic skills (from which all subsequent learning springs), it must be stressed from kindergarten on, experiences that help children develop creativity and higher level thinking skills. Most important, we must expect students at all ability levels to stretch beyond their academic comfort zones. Critical and analytical thinking can and must be taught to enable individuals to maximize their intelligence and perception as they use their information and experience in decision making (Miller, 1989, p. 40).

A news report by the Washington-based William T. Grant Foundations Commission on Youth and America's Future notes:

> The plight of the young person without advanced education, never easy, has become alarming in recent years. In a fast changing economy that demands increasingly specialized skills, these young people are in danger of being left at the starting gate (Social Science & the Citizen, p. 5, 1988, Volume No. 69).

"This nation may face a future divided not along lines of race or geography but of educational attainment," says the report, "The Forgotten Half: Non-College Bound Youth in America" (Shaw, 1988).

According to the Phi Delta Kappan (1985), proclaiming 1985-86 "the year of the elementary school," former secretary of Education William Bennett named a panel of noted educators, policy makers, and others to assess the condition of U.S. elementary schools. Bennett stated that:

> The time our children spend in elementary school is crucial to everything they will do for the rest of their lives; a student's success in school and work is determined in large measure by the foundation built during the elementary years (p. 324).

Day (1990) suggested the need for developmentally appropriate early childhood programs in schools for children as young as three years old. She made five (5) recommendations for public schools to meet the needs of young children:

1. Open public schools from 7:00 a.m. to 6:00 p.m. and offer summer school enrichment programs for all children from preschool through third grade.
2. Make the school entrance age three or four instead of five.
3. Establish special childhood units where a small group of teachers are responsible for children age four through eight.
4. Provide a developmentally appropriate program for all children that responds to different learning patterns and actively involve parents.

5. Do not use tests to place children in early childhood classrooms (p. 25).

A few years ago it was uncommon to have lasers, robots, or telecommunications equipment in our laboratories. Now, it is not uncommon to have elementary students telecommunicating with new friends half way around the world.

The report, "Educating Americans for the Twenty-First Century," (NSBC), 1983), science educators are moving rapidly toward the increased use of technology and a recognition of new roles for technology in science and science teaching. Youngsters are capable of learning more, fact for fact, in their earliest years than in the rest of his or her lifetime. The experiences must begin in the elementary years. In a recent science test taken by high school seniors in 14 nations, Americans ranked last. College enrollment in science courses are at an all-time low; and of high school students who do enter college with the intention of pursuing science careers, 60 percent change their minds by graduation.

Moos (1990), an editorial writer and columnist for The Dallas Morning News, said that:

> Many teachers, particularly those in elementary school, spent far more of their college years learning the art of teaching rather than studying the subject of science. As a result, they are uncomfortable following in the Mr. Wizard approach to science and education. They would rather have their students simply turn to page 18 in their textbooks. That has to change. The lack of proficiency in science among students today will lead to a shortage of biologists, chemists, engineers, physicists, and other scientists of tomorrow (p. 6A).

Technology Literacy

Today as we approach the twenty-first century the importance of technology literacy to the overall technological achievement cannot be underestimated. In the United States, the quest for technological literacy parallels our concern for the health of our entire education system. In the report, "National Goals on Education" (NCBE, 1990), President Bush and the nations fifty Governors declared six national performance goals for the United States to reach by the year 2000. The following goals are:

1. By the year 2000, all children in America will start school ready to learn.
2. By the year 2000, the high school graduation rate will increase to at least 90 percent.
3. By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter including science and mathematics.
4. By the year 2000, U.S. students will be first in the world in science and mathematics achievement.
5. By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.
6. By the year 2000, every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning (p. 1).

George Bush has said that he would like to be known as the education president, but his budget for education is less than Ronald Reagan's. If we want to restore America by having the most educated work force in the world by the year 2000, we must organize schools that address the realities of modern life.

The U.S. historically has been a technologically oriented country, yet we are not prepared to meet the challenge any more. Hart (1983) reports that our scientific and technical illiteracy is an embarrassment, if not an outright scandal.

1. Fewer than one in ten American high school students study even one year of physics.
2. American children study only one-third to one-half the math and science studied by their Japanese and Russian peers.
3. When students in 19 countries were ranked by their knowledge of science, Japanese students ranked first and Americans ranked fifth. Our toughest international competitors are doing a far better job than we are of preparing their children for life in a changed world (p. 12).

In the 1988 International Assessment of Education Progress, Stern (1991) elaborates that 13-year-olds from the U. S. scored in the lowest group in mathematics and science proficiency. In mathematics, 40 percent of the Korean students demonstrated the ability to deal with complex concepts, compared with nine percent of American students. In math, the U.S. finished behind students from Korea, Canada, Spain, the United Kingdom, and Ireland. Similarly, 33 percent of the Korean students could apply intermediate scientific principles, compared to seven percent of the American students. In science, the U.S. placed second to last, ahead only of Ireland.

Even more troubling is that, despite considerable investment in education, U.S. scores, in relationship to other countries, have been consistently low for the past 20 years (p. 4).

Rationale for Technology Education

Technology education is a unique element of the United States educational system. The major concern of technology education is the interaction of people, society, and industry. Technology education offers opportunities for students to be involved in learning activities related to their future roles as members of an industrial-technical society.

If students are to be contributing members of their society they must possess knowledge and understanding of the world in which they live. One of the major purposes of our educational system is to assemble, preserve, and transmit knowledge in a manner that promotes our culture.

Technology education activities provide situations where students actively learn by being directly involved in the use of tools, machines, materials, and processes. Students can also learn to analyze and apply the knowledge gained from other courses to their technology education activities. In technology education, students meet real-life situations and have an opportunity to solve problems which aid in developing decision-making skills, creativity, critical thinking, and problem solving procedures. Working with tools and machines cooperatively with other individuals is a valuable guidance regardless of the students future plans.

Technology education serves all levels of interest from the academically talented to the student who has difficulty in school, and from the elementary student to the college student. Under proper direction of the instructor, technology education can be made rewarding and challenging to all levels of students. All students can profit from a better understanding of the role of industry and technology in their everyday lives.

It is an established fact that children are naturally full of curiosity (Stewart and Findley, 1984). According to Olorundare (1988):

> curiosity; a motivation to learning also appears to be a biological endowment of the young human creature. Consequently, children want to know the hows and whys of the phenomena and processes in their environment; this child will be developed through a guided exposure to science. When children are denied this exposure, an important area of their development is suppressed. It is, therefore, the responsibility of adults to make accessible to children a variety of opportunities for interaction with their environment, to learn to face without fear situations that might have overwhelmed them with anxiety. In addition, the gratification of a child's curiosity requires touching, examining, smelling, tasting, exploring and looking inside; what his eyes see, he wants to get his hands on: These goals can all be achieved when science and technology education is allowed a respectable position in the school curriculum (p. 155).

Elementary School Technology Education Program

Technology for children is a program designed to develop unique technical learning environments for elementary students. According to the Iowa Department of Public Instruction (1986), Industrial Technology

Education Program for K-12 is unique in that it can contribute to general education by helping start:

- To foster awareness of industrial technology and its impact on society and the environment.
- To provide opportunities to explore a wide range of industrial situations as well as some of the technologies used in industry.
- To orient students to the industrial technologies of graphic communication, energy and power, manufacturing, construction and transportation.
- To use scientific principles, technical information and skills to solve problems related to an advanced technological society.
- To further students' career development by contributing to the students' knowledge and skills necessary for entering the work force or for additional education and training.

Therefore, the mission of Industrial Technology in Iowa is to help students become technologically literate and equipped with the necessary skills to cope with, live in, work in and contribute to a highly industrial/technological society (p. 4).

The state of Maryland has stressed in it plan for Technology Education (Maryland State Board of Education, 1980)a curriculum to meet the student's technological needs. The program offered in the elementary/ middle school is industrial education which emphasized the exploratory aspect of career education. The individual courses are organized around:

1. Content in a cluster of occupational fields: e.g., communication which includes design and drafting, printing processes, photography, other audio/visual media.
2. Activities which involve students in the processes (sequence of tool skills) required to plan, develop, and construct projects or to perform services, and/or repairs.
3. Perceived needs or interests of students (p. 2).

The program also places emphasis on the safety and proper use of a variety of hand tools. The vehicle by which students develop and achieve skills in industrial education is usually the individually-constructed project. However, as students become proficient in using tools, they are also able to perform service and repair work on items in and around the home and the school. The program should provide students with:

1. The opportunity to enrich and integrate their curricular experiences through participating in a variety of activities requiring the use of a wide selection of instructional tools and material.
2. The opportunity to make learning more effective through utilizing several of the senses in constructing objects relating to the subject to be learned.
3. Information and knowledge which enables them to understand the impact of industry and technology upon their lives (p. 6).

The state of Illinois has stressed in its plan for industrial education (Illinois State Board of Education, 1983) a curriculum to meet the students' technological needs. The plan has been developed from K-Adult. The basic objectives are:

1. To foster an awareness of industrial technology and its impact on society and the environment.
2. To provide opportunities to explore a wide range of industrial situations as well as some of the technologies used in industry.
3. To orient students to the industrial technologies of communication, energy utilization, production and transportation.
4. To use technical information and skills to solve problems related to an advanced technological society.
5. To prepare students with the necessary knowledge and skills to become gainfully employed or advanced in industrial-related occupations.

At the elementary and junior high school level, four one-semester courses have been developed and tested. These orient the student to five major technologies which are: communication, construction, manufacturing, transportation, and energy and power. There is evidence that these module components are beneficial to students. Technical components integrated into the main stream will become the norm rather than the exception (pp. 2-4).

Accumulating experiences is important to the science and technology learning of all children. Technology cannot occur in isolation, it must evolve with related disciplines such as math and computers. The report from NCFISE, 1989) also advocated that:

> A hands-on, inquiry-based science and technology program in elementary schools as the best possible preparation for all students, regardless of their circumstances. Hands-on science and technology teaches students to solve problems and to work cooperatively with others in seeking solutions--skills that are equally useful in advanced study in work and life (p. 19).

Buffer (1979) suggested that:

> Although the acquisition of career-related information and experience is continuous in one's life, purposeful learning experiences could be created to allow children to explore interests and capabilities in a variety of consumer-related occupations ranging from sales to law or from product design to servicing. Relevant laboratory experiences in industrial education can provide the referent to enable children to make more realistic and broadening career choices (p. 29).

Sprague (1988) further sustained this notion:

> To prepare themselves for a career within modern industry and business, a student's educational program must include all elements of high technology both theoretical and practical. This requires educators to integrate such content into existing courses as well as create new specialized courses of study (p. 12).

Mini-Invention Innovation Team Content (MIIT)

The MIIT Contest is co-sponsored by the technology for children (T4C) program of the New Jersey Department of Education's Division of Vocational Education and Career Preparation, and the Office for Promoting Technical Innovation (OPTI) of the New Jersey Department of Labor and Industry, and presented through Educational Improvement Center. It all began with classroom work in one school district. The program was created by Joan Barbagelata, a Middletown Township resource teacher.

Perusek (1981) reported that the growing interest in children's inventions culminated in a statewide workshop for teachers at which the Middletown teachers and students presented their ideas. The purpose of the program was to provide a spring board for teachers to generate invention activity in the classroom. In the first year, 329 students from all over the state participated. The next year there were twice as many. Regional winners had such ideas as:

- Solar Powered Car
- Battery Powered Duster
- Computer to Control Energy
- Thermo Convertor
- Sock Warmer
- Portable Burglar Alarm (p. 220).

Teachers are being presented with a system for teaching children how to seek out and solve problems by means of a systematic approach to inventing. Perusek (1981) mentions that:

> The long-range program will encourage wider participation and teach inventing in successive years so that children will advance in thinking, problem solving, and technical competencies. Goals are to help more children become more technically competent to solve problems generally and, more specifically, to be able to produce inventions of merit (p. 22).

Floden and Porter (1989) also states that:

> Elementary school teachers should place much greater emphasis in their instruction on the development of conceptual understanding and on providing opportunities to

> apply concepts and skills in formulating and solving problems (p. 13).

<u>Project Open</u>

Project Open (Peterson, 1980) was a joint curriculum development effort between the Wetzel County Board of Education and the Program for the Study of Technology at West Virginia University. The guidelines for program development were: the curriculum content was to be based on technology, it was to be developed for grades K-5, and the program was to be implemented by elementary classroom teachers (p. 15).

The following models were valuable in establishing a curriculum structure and defining the study of technology. Figure 1 (Devore, 1975) classifies the elements of technology according to systems which are apparent in all cultures--transportation, communication, and production. Certain levels of technology are recognized pre-historic through future, each with definable characteristics. Figure 2 (Skolimowski, 1976) was useful in establishing the parameters for the study of technology. While tools are perhaps the most obvious manifestations of technology, other dimensions defined by Henry K. Skolimowski are equally important and represent an expanded consciousness of the study of technology (pp. 24-25).

Using the technological approach, Figure 3 shows how students studied the effect of technology on the Native American Indian culture. Hands-on activities and tools were used in the process of creating models sharing the various aspects of the Indian's environment and the changing culture.

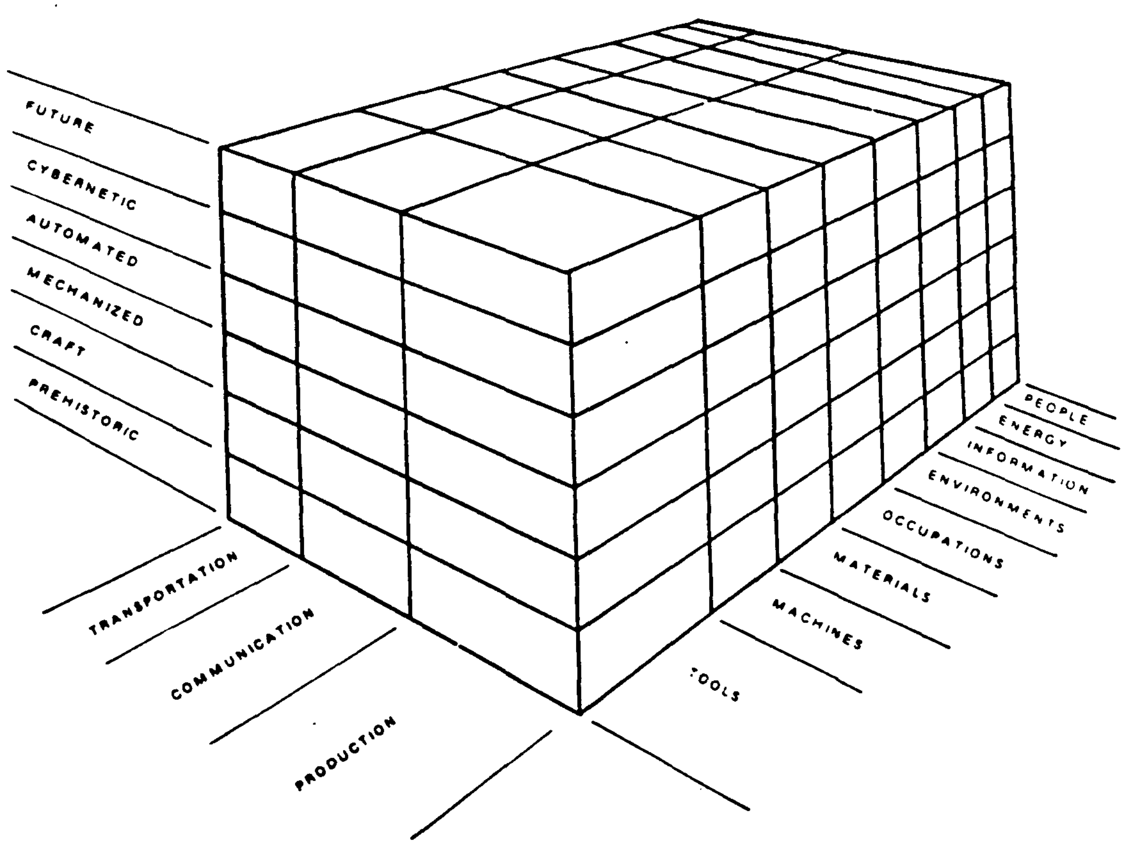

Figure 1. Curriculum content structure (DeVore, 1975)

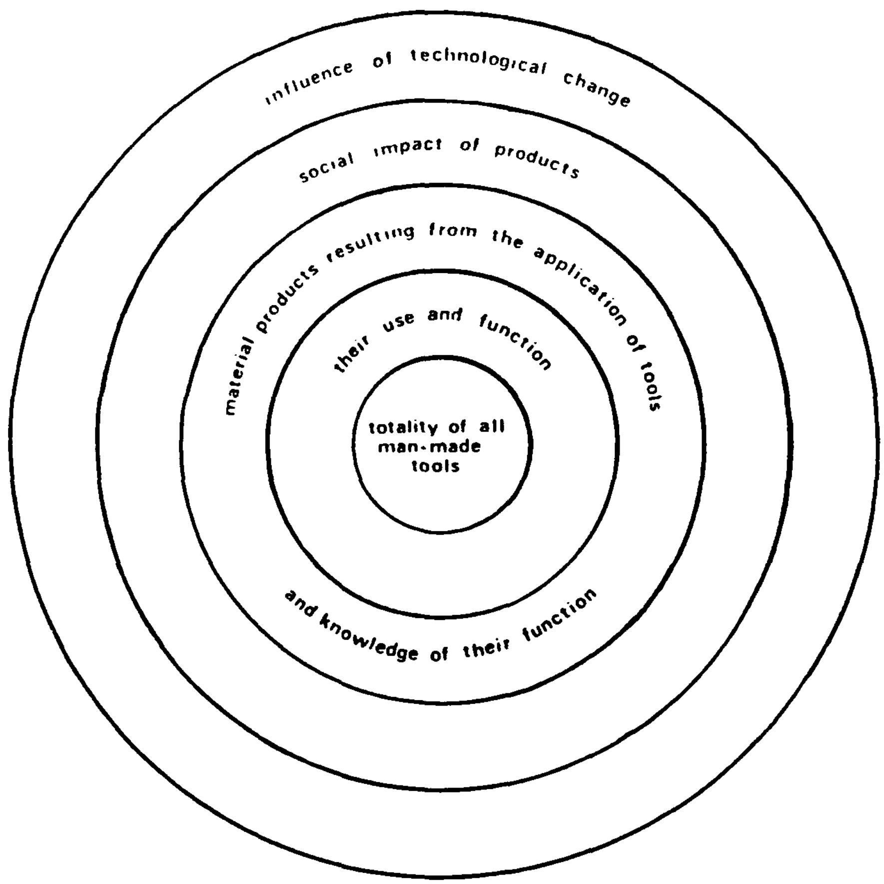

Figure 2. Henryk Skolimowski's five dimensions of the study of technology

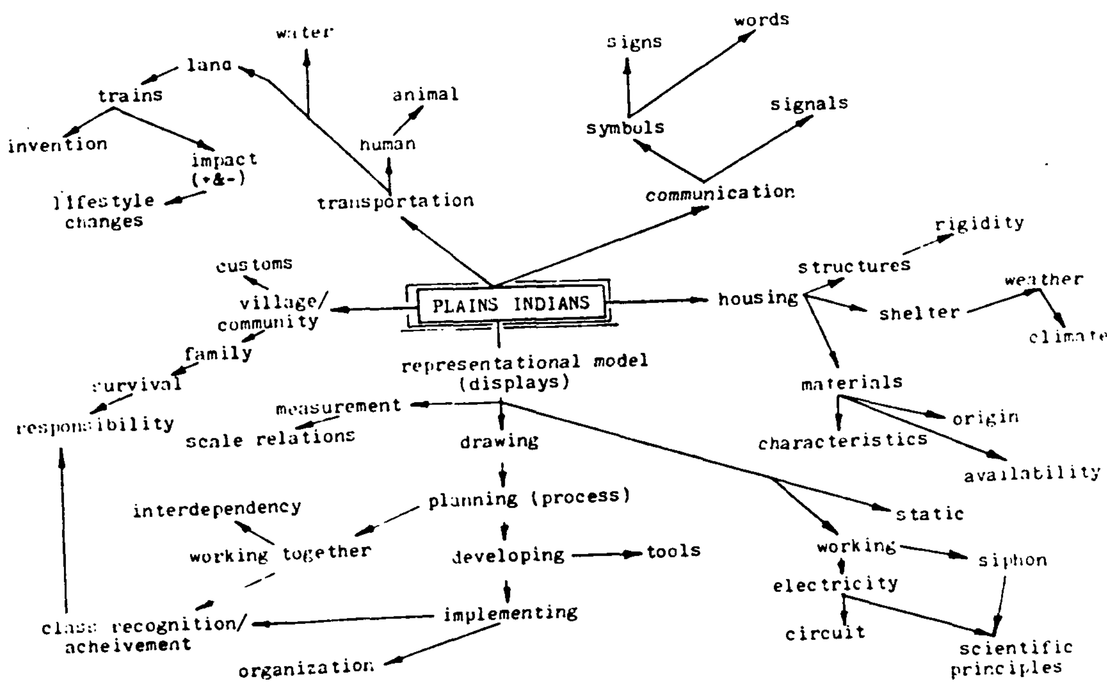

Figure 3. Curriculum webbing/sunburst technique

The curriculum webbing/sunbursting technique articulated the relationship between technology and the other discipline areas. Contributions of the study of technology to this typical elementary school theme were:

1. Recognition of technology and its influence. Specific aspects of the Plains Indian technology were discussed, simulated, and modeled.
2. Comparison of different levels of technology.
3. Construction, problem solving, and planning opportunities (p. 16).

At John Hanson Middle School in Charles County, Maryland (Maryland State Board of Education, 1986), the technology education program is based on a team-teaching approach. Elementary students spend all year in this program, which begins with a four to six weeks hands-on machine/tool orientation designed to develop the skills necessary to function safely and competently in the laboratory during the rest of the year. After this period the students undertake an in-depth study of technology. Since they can choose the topics to study after the initial orientation, the students participate in the program with a high degree of motivation.

On Wednesday, February 20, 1991, Crawford Elementary School in Ames, Iowa, played host to the Invent Iowa local invention convention. The inventions were judged on the basis of problem identification, research, originality, and state of completion.

1. The students identified a real need for the invention by explaining what problem the invention addresses and how it will make life better (or easier).
2. The students documented what similar inventions exist or existed. The student was required to do additional research to see if the invention is original. This was done by visiting appropriate stores, talking to adults, calling engineers, etc.
3. The invention is original, either in the problem it addresses or the solution.
4. The presentations showed that the student understood the creative problem-solving process and the work reflected the student's efforts.

Invent America

Invent America is a national education program and student invention competition designed to stimulate creativity and develop problem solving skills in millions of school children. The Invent America program is available to all public and private elementary school students in grades K-8.

Addressing a critical need in education today, Invent American is preparing students to assume the challenges of our increasingly complex and competitive technological world. Currently, almost half of all U.S. patents are awarded to foreign nationals, a dramatic increase from the 1960s. By rekindling the spirit of America ingenuity and inventiveness in our future workforce, Invent America is helping to keep America competitive.

Launched in 1987 by then-Vice President George Bush, who now serves as its honorary chairman, Invent America provides free educational materials and more than $600,000 in awards annually to schools, teachers and students. Invent America also sponsors national and regional conferences and in-service workshops for educators and parents.

Since its inception, more than 30,000 elementary schools have participated in the Invent America program, which culminates in the National Student Invention Competition in Washington, D.C. To reach the national finals, student inventors must first when in their school, state and regional competitions for their grade levels.

One student invention from each grade, kindergarten through eight, is selected for each state. From the state winners, 45 regional Invent America winners are named. The regional student winners, their parents and teachers then travel to Washington, D.C. to participate in the National Invent America festivities in July. Every child can participate and feel successful regardless of background, academic standing, physical abilities, and from special ed to the gifted and talented. Invent America levels the playing field and gives all students a chance to feel good about themselves.

The program is an example of a successful public/private partnership at work. Invent America's major corporate sponsors, which include Dow Chemical, K-Mart, Burroughs Wellcome, Lego Dacta, Polaroid, MasterCard International, and the Pepsi-Cola Company, play an important role in incorporating the program into classrooms across the country. Kiwanis International also recognizes Invent America as a major emphasis program and encourages its members to support Invent America at the local level. The Invent America Private Sector Partnership was singled out for recognition from among more than 140,000 such programs in SEcretary of Education Lauro Cavazos' special report to the President, "America's Schools: Everybody's Business," (Good Housekeeping Special Edition, 1990).

Summary

AT the very moment in history when technology and science touch American lives more deeply than ever before, there is compelling evidence that only a small percentage of the students who pass through the schools develop any useful scientific and technological understanding. The educational system may be continuing to produce enough highly trained engineers and scientists, but most Americans appear to lack even a basic understanding of technology and science.

Teachers must learn to address the students' learning styles and manage their learning. Reforming technology education in the elementary schools will be a difficult task, but it is not an impossible task.

Whether a culture is studied using the impact of technology on the people and their environment or if technology is studied as a means to solve local, national, or global problems, this brief review of literature of technology education in the elementary schools shows the importance it has in the lives of children. Success will come only if interested individuals at all levels of the system take up the challenge.

The review of literature also provided insight as to the current status and need of technology education in the school system. Furthermore, it has helped the investigator to construct an instrument for gathering relevant data.

CHAPTER III. METHODS AND PROCEDURES

This chapter describes the methods and procedures that the investigator used to collect and analyze data for the study. The study was conducted at Iowa State University in the department of industrial education and technology. The purpose of this study was to investigate what specific activities are utilized in the elementary teachers courses and what elementary students in selected Iowa elementary schools are learning about technology education. This chapter is divided into the following four parts:

1. Definition of population and identification of sample.
2. Instrument development.
3. Data collection procedure.
4. Data analysis procedure.

Definition of Population and Identification of Sample

The population of this study consisted only of teachers who participated in the industrial arts and career education workshops in the summers of 1980-81.

The sample size consisted of 30 teachers. A list of 1980-81 teachers was obtained from the Iowa State University, Iowa Curriculum Assistance Systems (ICAS).

Instrument Development

A survey instrument was used to collect data for this investigation. The instrument was designed to obtain information concerning the infusion of technology education in the elementary classroom. The instrument underwent many changes in its preparation and consisted of 47 items.

Section one consisted of four items needed to obtain information related to the teachers incorporation of industrial arts and career education in the classroom. It also contained questions about the number of students being taught, the grade levels of the students and rating the usefulness of the industrial and career education workshops held in the summers of 1980-81.

In section two, the clusters of technology were used to determine the frequency of their use. Items five through nine were used to collect information in relation to communication, items 10 through 14 were used in relation to construction, items 15 through 19 were used in relation to manufacturing, items 20 through 24 were used in relation to transportation, items 25 through 28 were used in relation to energy and power.

The third section provided information concerning the opinion the teacher emphasizes between the clusters of technology and the elementary education curriculum.

The fourth section provided items that may be perceived as a barrier which inhibit the elementary teacher to include the principles of technology.

The fifth and final section provided information about materials that are made available to help infuse technology principles in elementary education courses.

The data gathering instrument was checked by the major professor for wording, ambiguity, and appropriateness.

Data Collection Procedure

The survey instrument was mailed to a total of 30 elementary teachers. Harold Berryhill, of the Iowa Department of Education, was also contacted for more subjects of this study. Surprisingly, he told me that these were the only schools and teachers he was aware of that could be participants in my research. A cover letter was signed by the investigator and his major professor, and mailed with the instrument assuring confidentiality of all reported information.

The participants were asked to return the survey in an enclosed self-addressed stamped envelope. Both the cover letter and survey instrument (Appendices A and B) were approved by the Human Subjects Committee of Iowa State University.

The 30 surveys were coded by number to identify the teacher. After two weeks, the participants who did not respond to the instrument were telephoned. Two weeks after the telephone conversation, it was decided to cease data collection. There were 30 or 100% that were useable for data analysis.

Data Analysis Procedure

The investigator utilized the statistical package for the Social Science Program (SPSSX) (Norusis, 1983). After the surveys were returned, the researcher coded the instrument and entered the information into the Iowa State University computer system.

The computer program was written to produce a table of frequency counts and percentages for each individual variable. Means and standard deviations were also used to analyze the data collected. These results of the analysis are reported in Chapter IV.

CHAPTER IV. FINDINGS

This chapter contains results of the analysis of data collected for the study. The purpose of this study was to identify what specific activities with regard to technology education are being utilized in the elementary teachers courses in selected Iowa schools. The findings are based primarily on the data collected by means of a questionnaire. A total of 30 (100%) of the questionnaires were returned and found useable for the analysis of data.

In the remainder of the chapter, frequency tables along with means and standard deviations are used to report the data collected. The findings, relative to the purpose, are divided into five sections:

1. Incorporation and usefulness of industrial arts and career education.
2. Technology clusters being utilized in the classrooms.
3. Opinions of the technology clusters infused in the elementary education curriculum.
4. Factors which inhibit technology education among teachers.
5. In-service training and support.

Incorporation and Usefulness of Industrial Arts and Career Education

Table 1 illustrates the incorporation of industrial arts, crafts, applied arts, technology education and career education in selected Iowa elementary schools. Of the 30 schools responding, 83.3% stated that they are still incorporating industrial arts and career education, while 16.7%

Table 1. Elementary schools incorporating arts and career education

Industrial Arts and Career Education Incorporation	Frequency	Percent	Adj. Percent[a]
Yes	25	83.3	83.3
No	5	16.7	16.7
Total	30	100	100
Means = 1.167; S.D. = .379			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

Table 2. Rating the usefulness of the industrial arts and career education workshops

Usefulness of industrial arts and career education workshops	Frequency	Percent	Adj. Percent[a]
Very limited	1	3.3	5.3
Limited	8	26.7	42.1
Neutral	4	13.3	21.1
Extensive	4	13.3	21.1
Very Extensive	2	6.7	10.5
No Response	11	36.7	--
Total	30	100	100
Means = 2.895; S.D. = 1.150			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Response").

replied that due to increased requirements in math, reading, writing skills and P.E., they are no longer able to do so. A lack of facilities, equipment and the job responsibilities being altered also have had a negative effect.

Table 2 identifies the usefulness of industrial arts and career education workshops attended in the summers of '80-'81, 21.1% remained neutral and 31.6% expressed extensive or very extensive use of the results and experiences of the workshops.

Technology Clusters Being Utilized in Classrooms

Table 3 displays the rating of the clusters of technology being utilized in the classroom. This table contains a break-down of the five clusters of technology, which are communication, construction, manufacturing, transportation and energy and power.

The area of communication includes bookbinding, silk-screening, photography, computer games and telecommunications. In the area of bookbinding, 55.1% responded that it was never or occasionally used, 20.7% remained neutral, and 24.1% used it frequently or always. It was reported that 70% of the respondents never or occasionally used silk-screening, 13.3% remained neutral and 16.7% used silk-screening frequently or always. Photography, 76.7% reported the usage was never or occasional, 10% remained neutral and 15.4% indicated that it was used frequently or always. Computer games, 16.6% reported they were never or occasionally used, 10% remained neutral, and 73.3% reported that they utilized computer games frequently or always. Telecommunications, 43.3%

Table 3. Rating the clusters of technology being utilized in the classroom

COMMUNICATION

	Telecommunication	Photography	Silk Screen	Computer Games	Bookbinding	Percent[a]	Adj. %[a]
Never	9	15	18	4	11	38.0	38.24
Occasional	4	8	3	1	5	14.0	14.1
Frequent	7	3	4	3	6	15.32	15.46
Always	3	2	5	10	3	15.34	15.4
No Response	-	-	-	-	-	0.67	--
Total (30)						100	100

Avg. Means = 2.5694
Avg. S.D. = 1.7772

[a]The percentages in these columns represent the accumulated average of all the responses.

Table 3. Continued

CONSTRUCTION

	Metal Tooling	Ceramics	Glass	Designing	Hand Tools	Leather	Percent[a]	Adj. %[a]
Never	21	22	25	13	14	22	64.98	65.86
Occasional	3	4	1	2	9	3	12.21	12.28
Neutral	3	1	1	4	2	3	7.76	7.83
Frequent	2	1	2	5	3	1	7.78	7.85
Always	1	2	1	6	2	1	7.21	7.26
No Response	-	-	-	-	-	-	--	--
Total							100	100

Avg. Means = 1.783
Avg. S.D. = 1.2248

Table 3. Continued

MANUFACTURING

	Paper Maché	Plastics	Wood	Line Production	Percent[a]	Adj. %[a]
Never	8	21	10	11	41.67	42.27
Occasional	5	4	10	5	20.0	20.0
Neutral	11	3	9	7	25.0	25.0
Frequent	3	-	1	7	9.15	9.15
Always	3	1	-	-	3.32	3.32
No Response	-	1	-	-	0.825	--
Total (30)					100	100

Avg. Means = 2.112
Avg. S.D. = 0.882

Table 3. Continued

TRANSPORTATION

	Automation	Assembly	Handling Class Materials	Conveying	Trips	Percent[a]	Adj. %[a]
Never	19	11	5	22	6	42.0	43.72
Occasional	5	6	7	3	4	16.66	16.8
Neutral	4	9	6	2	11	21.34	21.86
Frequent	1	4	8	1	6	13.32	13.96
Always	1	-	1	-	3	3.32	3.32
No Response	-	-	3	2	-	3.34	--
Total (30)						100.00	100.00

Avg. Means = 2.1664
Avg. S.D. = 1.0768

Table 3. Continued

ENERGY AND POWER

	Robotics	Wax Candles	Recycling	Solar Energy	Percent[a]	Adj. %[a]
Never	21	25	2	4	43.32	43.32
Occasional	3	3	4	7	14.15	14.15
Neutral	2	-	9	9	16.67	16.67
Frequent	2	1	8	5	13.35	13.35
Always	2	1	7	5	12.5	12.5
No Response	-	-	-	-	--	--
Total (30)					100.00	100.00

Avg. Means = 2.375
Avg. S.D. = 1.167

implied that they were never or occasionally used, 23.3% remained neutral, and 33.3% used this area frequently or always.

The area of construction includes: metal-tooling, ceramics, glass, designing, and hand-tools. Of the respondents, 82.7% reported that they never or occasionally used metal tooling, 10.3% remained neutral, and 6.9% frequently or always used. Ceramics, 86.6% reported they never or occasionally incorporated ceramics, 3.3% remained neutral,a nd 10% frequently or always used ceramics. Glass, 89.6% reported that they never or occasionally incorporated, 3.4% remained neutral, and 6.9% frequently or always used glass. Designing, 50% replied that they never or occasionally infused, 13.3% remained neutral, 36.7% frequently or always incorporated designing. Hand tools, 76.7% implied that they never or occasionally utilized, 6.7% remained neutral and 16.7% reported that they utilized hand tools frequently or always.

The area of manufacturing included leather, paper mache, plastics, wood, and line production. Leather usage was reported as 83.3% never or occasionally, 10% remained neutral, and 6.6% frequently or always used. Paper mache usage was 43.4% never or occasionally, 36.7% remained neutral, and 20% frequently or always incorporated.

Plastics usage, 86.2% reported they never or occasionally used, 10.3% remained neutral, and 3.4% frequently or always incorporated. Wood usage, 66.6% of the respondents reported that they never or occasionally used, 30% remained neutral, and 3.3% frequently or always utilized wood. Line production, 53.4% reported that they never or occasionally incorporated, 23.3% remained neutral, and 23.3% frequently or always utilized.

The area of transportation included automation, assembling, handling of class materials, conveying, and field trips. Incorporation of automation was rated as 80% never or occasionally incorporated, 13.3% remained neutral, and 6.6% frequently or always incorporated. Assembling, 56.7% reported that they never or occasionally infused, 30% remained neutral, and 13% utilized assembling frequently or always. Handling of class materials was reported that 44.4% never or occasionally incorporated, 22.2% remained neutral, and 33.3% frequently or always utilized. Conveying reflects that 89.3% never or occasionally used, while 7.1% remained neutral, and 3.6% frequently or always incorporated. Only 33.3% reported that they never or occasionally took field trips, while 36.7% remained neutral, and 30% frequently or always took field trips.

The area of energy and power included robotics, wax candles, recycling, and solar energy. Robotics, 80% never or occasionally used, 0% remained neutral, and 13.4% frequently or always infused. Wax candles usage, 93% reported that they never or occasionally used, 0% remained neutral and 6.6% frequently or always used. Recycling, 20% reported that they never or occasionally utilized, 30% remained neutral, and 50% frequently or always incorporated. Solar energy, 36.6% reported that they never or occasionally used, 30% remained neutral, and 34.4% infused frequently or always.

The activities cited under "other" were: electrical units, soap making, models, camcorders, and safety.

Table 4 reflects the ranking of the technology clusters that are being incorporated in the classroom. Transportation, 32% reported that they ranked transportation as no or lowest priority, 20% remained neutral and 48% reported transportation as a priority or higher priority. Communication, 72% reported that they ranked communication as no or lowest priority, 16% remained neutral, and 12% reported a priority or higher priority. Manufacturing, 8.3% reported that they ranked manufacturing as no or lowest priority, 26.9% remained neutral, and 30.8% reported construction as a priority or higher priority. Energy, 52% reported that they ranked energy as no or lowest priority, 12% remained neutral and 36% reported energy as a priority or higher priority.

Teachers' Opinions of Technology Clusters Within the Elementary Education Curriculum

Table 5 reports the frequency of opinions between the clusters of technology within the elementary education curriculum. The areas involved were language arts, social studies, mathematics, science, art, health/P.E., and music.

Language arts, 24% reported that the usage was extremely weak or very weak, 40% remained neutral, and 35% reported that the usage of language arts was very strong or extremely strong. Social studies, 16% reported that the usage of social studies was extremely weak or very weak, 44% remained neutral, and 30% reported the usage of social studies was very strong or extremely strong. Mathematics, 29.2% reported the usage of mathematics as extremely weak or very weak, 16.7% remained

Table 4. Ranking the technology clusters that are being incorporated in the classrooms

Ranking technology clusters	Frequent	Percent	Adj. Percent[a]
Transportation			
Lowest Priority	2	6.7	8.0
Lower Priority	6	20.0	24.0
Neutral	5	16.7	20.0
High Priority	7	23.3	28.0
Highest Priority	5	16.7	20.0
No Response	5	16.7	--
Total	30	100	100
Means = 3.280 S.D. = 1.275			
Communication			
Lowest Priority	15	50.0	60.0
Lower Priority	3	10.0	12.0
Neutral	4	13.3	16.0
High Priority	2	6.7	8.0
Highest Priority	1	3.3	4.0
No Response	5	16.7	
Total	30	100	100
Means = 1.840 S.D. = 1.214			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Table 4. Continued

Ranking technology clusters	Frequent	Percent	Adj. Percent[a]
Manufacturing			
Lowest Priority	2	6.7	8.0
Lower Priority	-	--	--
Neutral	6	20.0	20.0
High Priority	7	23.3	29.2
Highest Priority	9	30.0	37.5
No Response	6	20.0	--
Total	30	100	100
Means = 3.875			
S.D. = 1.191			
Construction			
Lowest Priority	4	13.3	15.4
Lower Priority	7	23.3	26.9
Neutral	7	23.3	26.9
High Priority	6	20.0	23.1
Highest Priority	2	6.7	7.7
No Response	4	13.3	
Total	30	100	100
Means = 2.808			
S.D. = 1.201			

Table 4. Continued

Ranking technology clusters	Frequent	Percent	Adj. Percent[a]
Energy and Power			
Lowest Priority	3	10.0	12.0
Lower Priority	10	33.3	40.0
Neutral	3	10.0	12.0
High Priority	2	6.7	8.0
Highest Priority	7	23.3	28.0
No Response	5	16.7	--
Total	30	100	100
Means = 3.000 S.D. = 1.472			

Table 5. Opinion of technology clusters within the elementary education curriculum

Rating of opinion	Frequency	Percent	Adj. Percent[a]
Language Arts			
Extremely Weak	6	20.0	24.0
Very Weak	-	--	--
Neutral	10	33.3	40.0
Very Strong	7	23.3	28.0
Extremely Strong	2	6.7	8.0
No Response	5	16.7	
Total	30	100	100
Means = 2.960 S.D. = 1.274			
Social Studies			
Extremely Weak	4	13.3	16.0
Very Weak	-	--	--
Neutral	11	36.7	44.0
Very Strong	4	13.3	16.0
Extremely Strong	6	20.0	24.0
No Response	5	16.7	--
Total	30	100	100
Means = 3.320 S.D. = 1.314			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Table 5. Continued

Rating of opinion	Frequency	Percent	Adj. Percent[a]
Mathematics			
Extremely Weak	4	13.3	16.7
Very Weak	3	10.0	12.5
Neutral	4	13.3	16.7
Very Strong	6	20.0	25.0
Extremely Strong	7	23.3	29.2
No Response	6	20.0	25.0
Total	30	100	100
Means = 3.375 S.D. = 1.469			
Science			
Extremely Weak	2	6.7	7.7
Very Weak	5	16.7	19.2
Neutral	5	16.7	19.2
Very Strong	8	26.7	30.8
Extremely Strong	6	20.0	23.1
No Response	4	13.3	
Total	30	100	100
Means = 3.423 S.D. = 1.270			

Table 5. Continued

Rating of opinion	Frequency	Percent	Adj. Percent[a]
Art			
Extremely Weak	3	10.0	12.5
Very Weak	3	10.0	12.5
Neutral	10	33.3	41.7
Very Strong	3	10.0	12.5
Extremely Strong	5	16.7	20.8
No Response	6	20.0	
Total	30	100	100
Means = 3.167 S.D. = 1.274			
Health/P.E.			
Extremely Weak	11	36.7	47.8
Very Weak	3	10.0	13.0
Neutral	8	26.7	34.8
Very Strong	1	3.3	4.3
Extremely Strong	-	--	--
No Response	7	23.3	
Total	30	100	100
Means = 1.957 S.D. = 1.022			

Table 5. Continued

Rating of opinion	Frequency	Percent	Adj. Percent[a]
<u>Music</u>			
Extremely Weak	11	36.7	52.4
Very Weak	6	20.0	28.6
Neutral	3	10.0	14.3
Very Strong	1	3.3	4.8
Extremely Strong	-	--	--
No Response	9	30.0	
Total	30	100	100
Means = 1.714 S.D. = 0.902			

neutral, and 34.2% reported that the usage of mathematics was very strong or extremely strong. Science, 26.9% reported the usage of science as being extremely weak or very weak, 19.2% remained neutral and 53.9% reported the usage as very strong or extremely strong. Art, 25% reported that the usage of art was extremely weak or very weak, 41.7% remained neutral and 33.3% report that the usage of art was very strong or extremely strong. Health/P.E., 50.8% reported that the usage of health/P.E. as extremely weak or very weak, 34.8% remained neutral, and 4.3% reported that the usage of health/P.E. was very strong or extremely strong. Music, 80% reported that the usage of music was extremely weak or very weak, 14.3% remained neutral and 4.8% reported the usage of music as very strong or extremely strong.

Factors Which Inhibit Technology Education Among Teachers

Table 6 reflects the factors that have been encountered as barriers to technology education among the teachers. The following barriers were rated: unfamiliarity with hardware and materials, uneasy sense towards added responsibility for technology which will increase a teacher's workload, lack of time to create new experiments related to new technology, dissatisfaction with software unavailable and inadequate facilities and equipment to provide meaningful student experience to the instructional level.

Unfamiliarity with hardware and materials was reported as 0% strongly disagree or disagree, 28.6% remained neutral, and 71.4% reported that they agree or strongly agree. Uneasy sense towards added responsibility was reported that 10.7% strongly disagree or disagree, 14.3% remained neutral, and 75% reported that they agree or strongly agree. Lack of time to create new experiments was reported as 7.1% strongly disagree or disagree, 3.6% remained neutral, 89.3% reported that they agree or strongly agree. Dissatisfaction with software available was reported that 32.2% strongly disagree or disagree, 39.3% remained neutral, and 28.6% reported that they agree or strongly agree. Inadequate facilities and equipment reported that 14.2% strong disagree or disagree, 3.5% remained neutral, and 82.2% reported that they agree or strongly agree.

Table 6. Factors encountered most as barriers to technology education among teachers

Barriers	Frequency	Percent	Adj. Percent[a]
Unfamiliarity			
Strongly Disagree	--	--	--
Disagree	--	--	--
Neutral	8	26.7	28.6
Agree	13	43.3	46.4
Strongly Agree	7	23.3	25.0
No response	2	6.7	
Total	30	100	100
Means = 3.964 S. D. = 0.744			
Uneasy Sense			
Strongly Disagree	--	--	--
Disagree	3	10.0	10.7
Neutral	4	13.3	14.3
Agree	10	33.3	35.7
Strongly Agree	11	36.7	39.3
No response	--	--	--
Total	30	100	100
Means = 4.036 S. D. = 0.999			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Table 6. Continued

Barriers	Frequency	Percent	Adj. Percent[a]
<u>Lack of time</u>			
Strongly Disagree	2	6.7	7.1
Disagree	--	--	--
Neutral	1	3.3	3.6
Agree	12	40.0	42.9
Strongly Agree	13	43.3	46.4
No response	2	6.7	--
Total	30	100	100
Means = 4.214 S. D. = 1.067			
<u>Dissatisfaction</u>			
Strongly Disagree	1	3.3	3.6
Disagree	8	26.7	28.6
Neutral	11	36.7	39.3
Agree	3	10.0	10.7
Strongly Agree	5	16.7	17.9
No response	2	6.7	--
Total	30	100	100
Means = 3.107 S. D. = 1.133			

Table 6. Continued

Barriers	Frequency	Percent	Adj. Percent[a]
Inadequate facilities			
Strongly Disagree	2	6.7	7.1
Disagree	2	6.7	7.1
Neutral	1	3.3	3.6
Agree	8	26.7	28.6
Strongly Agree	15	50.0	53.6
No response	2	6.7	--
Total	30	100	100
Means = 4.143 S. D. = 1.230			

In-Service Training and Support

Tables 7 through 11 include summary of responses of the desirability of in-service training workshops and special courses to be offered at I.S.U. The extent of support from the teachers' administrators and the encouragement from parents for the infusion of technology education toward technological education.

Table 7 represents the responses of teachers as to whether or not during the past ten years, these particular teachers have had any in-service training or workshops concerning career education, industrial arts, crafts, applied art or technology education. Of the respondents, 28.6% replied that they had attended workshops or in-service training and 71.4% stated that they had not.

Table 7. In-service training or workshops during last 10 years

Responses	Frequency	Percent	Adj. Percent[a]
Yes	8	26.7	28.6
No	20	66.7	71.4
No Response	2	6.7	--
Total	30	100	100
Means = 1.714 S. D. = 0.460			

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Even though most had not attended, the teachers that had attended stated that the areas were: art lessons, career education, robotics, and CAD.

Table 8 reflected responses on whether or not the teachers were involved in any personal development of instructional materials to infuse technical education principles and content. Replies of 37.9% were yes and 62.1% stated no. The areas that had been developed were electrical and construction. The development of the Department of Education elementary industrial technology guide had been written

Table 9 expressed the teachers' interest in special courses or in-service training workshops at I.S.U. The replies were that 31% replied yes and 69% replied no. There were also responses that they would attend if it would apply to teachers renewal credits, and also possibly that

Table 8. Personal development of instructional materials to infuse technology principles and content

Responses	Frequency	Percent	Adj. Percent[a]
Yes	11	36.7	37.9
No	18	60.0	62.1
No Response	1	3.3	--
Total	30	100	100

Means = 1.621
S. D. = 0.494

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Table 9. Teacher's interest in special courses or in-service training workshops at ISU

Responses	Frequency	Percent	Adj. Percent[a]
Yes	9	30.0	31.0
No	20	66.7	69.0
No Response	1	3.3	--
Total	30	100	100

Means = 1.690
S. D. = 0.471

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

they would like to attend at another time. The areas of interest were communication, glass, energy and power, micro-wave communication, publishing and printing, robotics, electronics, and the history of Iowa technology.

Table 10 indicates the extent of support from the teacher's administrator to infuse technological education. It was based on the following: 71.5% reported very limited or limited support, 14.3% remained neutral, and 14.3% reported extensive or very extensive support.

Table 11 reflects the degree of support that the teacher received from parents to encourage the use of technology education. Responses were 59.2% very limited or limited support, 25.9% remained neutral, and 14.8% reported extensive or very extensive support from parents.

Research Questions

Question 1

What clusters of technology education are being incorporated in the elementary classroom?

Table 3 provides information concerning the clusters of technology education being incorporated into the elementary classroom. The results of the respondents indicated that by involvement in certain activities, all the clusters with the exception of construction, made a certain impact and showed potential application of the clusters being incorporated in the classroom.

Table 10. Extent of support from teacher's administrator to infuse technology education

Degree of Support	Frequency	Percent	Adj. Percent[a]
Very Limited Support	5	16.7	17.9
Limited Support	15	50.0	53.6
Neutral	4	13.3	14.3
Extensive Support	3	10.0	10.7
Very Extensive Support	1	3.3	3.6
No Response	2	6.7	--
Total	30	100	100

Means = 2.286
S. D. = 1.013

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Table 11. Extent of support from parents to encourage technology education

Degree of Support	Frequency	Percent	Adj. Percent[a]
Very Limited Support	9	30.0	33.3
Limited Support	7	23.3	25.9
Neutral	7	23.3	25.9
Extensive Support	1	3.3	3.7
Very Extensive Support	3	10.0	11.1
No Response	3	10.0	--
Total	30	100	100

Means = 2.333
S. D. = 1.301

[a]The percentage in this column has been calculated based on the number of respondents remaining after eliminating missing answers (including "No Responses").

Question 2

Does the elementary teacher incorporate the clusters of technology within the elementary education curriculum?

It was reported that the clusters of technology were being incorporated into the math and science curriculum very strong as indicated in Table 5. More than one-half of the elementary teachers rated that they incorporated the clusters of technology in their classroom.

<u>Question 3</u>

What problems or barriers exist which inhibit the elementary teacher to include the principles of technology?

It was found as reported in Table 6 that over 8% of the teachers agreed strongly that the lack of time was the barrier that existed which inhibit the elementary teacher to include the principles of technology, followed by inadequate facilities and equipment, uneasy sense toward added responsibility, unfamiliarity with hardware materials and dissatisfaction with software.

<u>Question 4</u>

Are the materials that are made available being utilized to help infuse technology principles in elementary education courses?

Tables 7-9 provide results to research question four. More than 70% of the teachers reported that they have not had any in-service training or workshops concerning industrial arts, crafts, applied arts, technology education or career education since school year 1980-81. More than one-half of the teachers also reported that they have not developed instructional materials, nor would they be interested in special courses or workshops.

Summary of Findings

The results of the analysis covered five basic areas: incorporation and usefulness of industrial arts and career education, evaluation of technology clusters infused in the classroom, opinion of the technology clusters within the elementary education curriculum, factors which inhibit technology education among teachers and in-service training and support.

The first objective was to identify if technology education was still being incorporated in the classroom. Most of the teachers (83.3%) reported that they are still incorporating technology education in their classroom. Only 30% of the elementary teachers reported that the industrial arts and workshops were useful in their classroom ten years after their participation.

The next objective was to identify what cluster(s) of technology education are being incorporated in the elementary classroom. Findings conveyed that communications and energy and power were the clusters that were frequently and always being incorporated in the elementary classroom and manufacturing was ranked as first priority. The findings indicated that about half of the elementary teachers rated math (54%) and science (53.9%) very strongly toward infusing technology education in the elementary education curriculum.

Lack of time (89.3%) and inadequate facilities/equipment (82.2%) were the problems or barriers inhibiting the classroom teacher to include the principles of technology. The elementary teachers (67%) reported that they have not had any workshops or in-service training nor developed instructional materials on their own. They also reported that there was only limited support from both the administrators and parents for infusing technology education principles in the elementary curriculum.

CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The previous four chapters of this research consisted of the introduction, review of literature, methods and procedures, and results of the research. The intent of this chapter is to summarize the preceding chapters, draw conclusions based on the results, and present recommendations for further research.

Summary and Conclusions

This section provides a summary and the conclusions of the study, which are presented in relation to each research question. The four research questions are restated followed by a brief discussion of the findings.

Restatement of the Problem

This study was designed to investigate the technology education program in selected elementary schools in Iowa. It is not intended to evaluate these programs, but only to determine what the students are learning.

Restatement of the Purpose

The purpose of this study was to identify, by means of a survey, what specific activities are being utilized, what clusters of technology are being infused, and what students are learning about technology education in selected elementary schools in Iowa.

Research question 1

What clusters of technology education are being incorporated in the elementary classroom?

Discussion Based on the results found in TAble 3, it was reported that in the majority of schools surveyed, certain activities such as computer games, telecommunications, paper mach , recycling and solar energy made an impact on the technology clusters of communication, manufacturing, transportation, and energy and power to be incorporated in the classroom. Due to the choice of activities selected, there may have been a higher rating of the technology clusters being infused in the classroom.

Research question 2

Does the elementary teacher incorporate the clusters of technology within the elementary education curriculum?

Discussion It is concluded, based on the results found in Table 5, that more than 60% of the teachers expressed very strongly that the clusters of technology are being incorporated into their elementary education curriculum. For example, a teacher stated on the survey that the cluster of construction was being infused into mathematics by the discussion of geometric shapes and sizes.

Research question 3

What problems or barriers exist which inhibit the elementary teacher to include the principles of technology?

Discussion Table 6 summarized the results of barriers to technology teaching among teachers. It is concluded that teachers extremely or strongly agree that the most frequently encountered barriers are unfamiliarity with hardware, materials, uneasy sense towards added responsibility for technology developments which will increase a teacher's workload, lack of time to create new experiments related to new technology and inadequate facilities and equipment to provide meaningful student experiences for the particular instructional level.

Research question 4

Are the materials that are made available being utilized to help infuse technology principles in elementary education courses?

Discussion The results in Tables 7-9 show that in the past ten years, 71.49 percent of the teachers responded that they have not had any in-service training or workshops concerning industrial arts, career education, crafts, applied arts, or technology education. The majority of the teachers (62.1%) reported that they have not developed instructional materials on their own initiative to infuse technology principles and content.

Table 9 indicated that 69.0 percent of the teachers would not be interested in special courses or in in-service training workshops to be offered by ISU. Thirty percent of the teachers indicated that they would be interested only if it goes toward credit to certification and teacher renewal.

Therefore, it is concluded that the materials that are available are not being utilized to infuse technology principles in elementary education courses.

Recommendations

This section of the study contains recommendations for further research in this area. Based on the findings of the study, the following recommendations were made:

1. It is recommended that this study be duplicated with a larger population size after a period of time to determine if there is any progress in the infusion of technology education in selected Iowa elementary schools.
2. It is recommended that efforts be made to extend the knowledge of and implications of technology education programs for developing appropriate instruction for elementary students.
3. It is recommended that more time be allotted for teachers to teach technology education activities in their classroom.
4. It is recommended that technology education be implemented in the elementary school with technology as the content base after teachers receive in-service experiences.
5. Further work is recommended to continually update and evaluate hardware material and software availability on technology education for elementary teachers.
6. It is recommended that administrators should support and encourage teachers to participate more in workshops and in-service training.

REFERENCES

Buffer, James J. (1979). Industrial Arts & Consumer Education, Man/Society/Technology, 39(3), 28-29.

Cavozos, Lauro. (1990). Rekindle the Spirit of American Ingenuity. A Good Housekeeping Special Edition, p. 1A-3.

Chira, Susan. (1991, March). The Tough Task of Improving Schools, The Des Moines Register, p. 1C. Des Moines, Iowa.

Crim, Alonzo. (1990, Spring). Education Changes in the Next Decade. News, Notes, and Quotes, 79, 24.

Day, Barbara. (1990, Spring). Education Changes in the Next Decade. News, Notes, and Quotes, 79, 25.

Dewey, John. (1902). The Child and the Curriculum, Chicago: The University of Chicago Press.

Dewey, John. (1915). The School and Society, Chicago: The University of Chicago Press.

DeVore, P. W. (1975). Middle School Technology, West Virginia University. (Mimeographed).

Evans, Dean. (1983, Nov.). We Must Begin Educational Reform 'Every Place at Once', Phi Delta Kappan, 65, 173-177.

Floden, R. E. & Porter, A. C. (1989). Content Determinants in Elementary School Mathematics, Educational Researcher, 18(5), 9-11.

Friedman, E. A. (1980). Dimensions of Technological Literacy in Liberal Education. The Technology Teacher, 65(2), 28.

Funk & Wagnalls. (1986). Encyclopedia, 14, 69. Donnelly & Sons Co.

Futrell, May. (1989). Mission Not Accomplished: Education Reform in Retrospect, Phi Delta Kappan, 71, 8-14.

Hart, Gary. (1983, Feb.). Investing in People for the Information Age, Futurist, 17, 10-14.

Hicken, J. C. (1982). Technology in Elementary School, Man/Society/Technology, 41(6), 22.

Hoots, W. R. (1980). Industrial ARts in the Elementary School. Education for a Changed Society, Washington, D.C.: American Council for Elementary School Industrial Arts. (ACESIA Monograph 8).

House of Representatives, Subcommittee on Elementary, Secondary and Vocation Education, Committee on Education and Labor. The Education Technology Act. Preceding of a Congressional Subcommittee. Washington, D.C., February 19, 1986. (ERIC Document Reproduction Service No. ED 280 732).

Illinois State Board of Education. (1983). A Planning Guide. Springfield, Illinois. 2-4.

Iowa Curriculum Assistance System. (1986). Introduction to Technology. Iowa State University, Ames, Ia.

Iowa Department of Instruction. (1986). Industrial Technology Program, K-12.

Janey, Clifford. (May, 1989). Technology in the Classroom: A Chance for Equity, Equity and Choice, 33-34.

Keller, Denise. (1978). The Development of an Industrial ARts Program for the Elementary School, K-3. Unpublished doctoral thesis, Iowa State University, Ames, Ia.

Lewis, Anne C. (1989). Washington Commentary: A Box Full of Tools, But No Blueprint, Phi Delta Kappan, 71, 180-181.

Miller, W. R. (1989). Contemporary Challenges for Industrial Education: A Reaction. Journal of Industrial Teacher Education, 26(2), 2-41.

Montgomery County Public Schools. (1979, Spring). Industrial Arts, K-8, Department of Instructional Planning and Development. Rockville, Md.

Moos, Robert. (1990). Science Education Doesn't Have to be Boring. Janesville Gazette, p. 6A. Janesville, Wi.

National Center for Improving Science Education. (1989). Getting Started in Science, A Blueprint for Elementary School Science Education, 26(2).

National Clearinghouse for Bi-Lingual Education. (1990, Sept.). Special Research Issue, Title VII Research and Evaluation Update, XIII(6), 1-2.

Norusis, Marija J. (1983). Introductory Statistic Guide, (SPSSX). McGraw Hill Book Co., New York.

Olorundare, Solomon A. (1988). Scientific Literacy in Nigeria, International Journal of Science Education, 10(2), 151-158.

Paige, William. (1991). Department of Industrial Education and Technology, Iowa State University, Ames, Ia.

Perusek, Wesley. (1981). New Jersey Teaches Its Children to Invent. Educational Leadership, 39(3), 220.

Perusek, Wesley. (1985). Real Task of Reform is Still to Come. Phi Delta Kappan, 67, 321.

Peterson, Richard E. (1977). Peden City Elementary School Project, Annual Report of Project Open. West Virginia University, Paden City, West Virginia. 15.

Shaw, Ned. (1988). The Forgotten Half: On-College Bound Youth in America, Phi Delta Kappan, 69, 408-414.

Skolimowski, Henry K. (1970). Extension of Technology: From Utopia to Reality, American Industrial Arts Association, 50(6), 24-35.

Splete, A. P. (1986). Technology and Liberal Education. Small Talk, 2(1), 2a.

Sprague, Norman G. (1941). Basic Laboratory Practices. Elementary Manual of Fundamental Techniques. Chemical Publishing Co., Brooklyn, New York.

Stern, Barry E. (1991). Technology Education as a Component of Fundamental Education: A National Perspective, The Technology Teacher, 50(4), 13.

Stewart, J. & Findley, F. (1984). Science in the Elementary School: Some Basic Considerations. Preparing for Reflective Teaching, Boston: Allen and Bacon.

The Merriam/Webster Dictionary. (1986). Springfield, MA: G. C. Merriam.

The National Commission on Excellence in Education. (1983). A Nation at Risk: The Imperative for Educational Reform. Washington, D.C.: U.S. Government Printing Office.

Tyler, Ralph. (1990). Education Changes in the Next Decade, News, Notes, and Quotes, 79, 24.

Whitehead, A. N. (1929). Aims of Education, Educational Research, 18(5), 14.

Zuckerman, M. B. (1989). The Illiteracy Epidemic. U.S. News & World Report, 30(6), 72.

ACKNOWLEDGEMENTS

I would like to thank my Lord and Savior, Jesus Christ, for making this possible. Special thanks go to Dr. William Wolansky, my major professor, and Drs. Don McKay and Dale Baum for all their assistance.

I am very appreciative of Dr. George Jackson for his guidance, support, and financial assistance through every phase of this research. Also, to all my old and new friends, thanks.

Last, but not least, I would like to thank Carol Lattig for her love, patience, and understanding.

APPENDIX A. SURVEY INSTRUMENT

Survey Instrument

Code No.______________

INSTRUCTIONS: Please answer the following questions by placing your response in the space provided or circle your response where applicable.

Part I

1. Are you still incorporating industrial arts, crafts, applied arts, technology education, or career education at your local school?

____________Yes

____________No Please explain briefly what you are doing.

2. How many students do you teach?___________(Total)

3. What are the grades?

Please answer the questions on a scale from 1 to 5. Consider 5 as the highest value.

4. Please rate the usefulness of the Industrial Arts and Career Education workshops in the summers of 1980-81.

Please circle your response
Limited Use   Extensive Use

1 2 3 4 5

Part II

Please rate the following areas that you utilize in your classroom.

	Please circle your response Never				Frequent
5. Book Binding	1	2	3	4	5
6. Silk Screening	1	2	3	4	5
7. Photography	1	2	3	4	5
8. Computer Games	1	2	3	4	5
9. Telecommunications	1	2	3	4	5
10. Metal Tooling	1	2	3	4	5
11. Ceramics	1	2	3	4	5
12. Glass	1	2	3	4	5
13. Designing	1	2	3	4	5
14. Hand Tools	1	2	3	4	5
15. Leather	1	2	3	4	5
16. Paper Mach	1	2	3	4	5
17. Plastics	1	2	3	4	5
18. Wood	1	2	3	4	5
19. Line Production	1	2	3	4	5
20. Automation	1	2	3	4	5
21. Assembling	1	2	3	4	5
22. Handling of Class Materials	1	2	3	4	5
23. Conveying	1	2	3	4	5
24. Field Trips (airports, factories, etc.)	1	2	3	4	5
25. Robotics	1	2	3	4	5

	Please circle your response Never Frequent				
26. Wax Candles	1	2	3	4	5
27. Recycling	1	2	3	4	5
28. Solar Energy (wind, water, sun)	1	2	3	4	5

29. Other Specify ______________________________

30. Please rank the following technology clusters that are incorporated in your classroom. Start with the number "1" being the first priority.

__________Transportation (air, land, water transportation)
(calculate miles per gallon chart)
$(\text{m.p.g.} = \frac{\text{miles}}{\text{gallons}})$

__________Communication (audiovisual, drawings, symbols, etc.)

__________Manufacturing (toy making, processes, textiles, etc.)

__________Construction (crafts, agriculture, basic hand tools, etc.)

__________Energy & Power (mechanical, heat, solar energy, etc.)

Part III

Please rate in your opinion the emphasis between the teaching of the clusters of technology education (communication, manufacturing, transportation, construction, energy & power) to the following areas of the elementary education curriculum.

	Please circle your response Very Weak Very Strong				
31. Language Arts	1	2	3	4	5
32. Social Studies	1	2	3	4	5
33. Mathematics	1	2	3	4	5
34. Science	1	2	3	4	5

	Please circle your response Very Weak				Very Strong
35. Art	1	2	3	4	5
36. Health/P.E.	1	2	3	4	5
37. Music	1	2	3	4	5

Part IV

Please rate, in your opinion, the following items that may be perceived as a barrier to technology education teaching among teachers.

	Please circle your response Strongly disagree				Strongly agree
38. Unfamiliarity with hardware and materials	1	2	3	4	5
39. Uneasy sense towards added responsibility for technology developments which will increase a teacher's workload	1	2	3	4	5
40. Lack of time to create new experiments related to new technology	1	2	3	4	5
41. Dissatisfaction with the software available	1	2	3	4	5
42. Inadequate facilities and equipment to provide meaningful student experiences to the instructional level.	1	2	3	4	5

Part V

43. During the past 10 years, have you had any in-service training or workshops concerning career education, industrial arts, crafts, applied arts or technology education? If yes, please specify topics.

_________Yes 1. ____________________

_________No 2. ____________________

3. ____________________

44. I have developed instructional materials on my own initiative to infuse technology education principles and content.

_________Yes

_________No

45. Would you be interested in special courses or in-service training workshops?

Please specify topics.

_________Yes 1. _________________________

_________No 2. _________________________

3. _________________________

46. To what extent do you feel that your administrator has been supportive and has encouraged the use of technology education and awareness in the classroom?

Please circle your response

Limited support				Extensive support
1	2	3	4	5

47. To what extent do you feel that the student's parents have been supportive and encouraged the inclusion of technology in the classroom?

<u>Please circle your response</u>				
Limited support				Extensive support
1	2	3	4	5

APPENDIX B. COVER LETTER

IOWA STATE
UNIVERSITY

College of Education
Department of Industrial
Education and Technology
Ames, Iowa 50011
Telephone: 515-294-1033

Dear

I am a graduate student at Iowa State University currently working towards a Masters degree in Industrial Education and Technology. I am conducting research to meet the requirements for my thesis. The purpose of this questionnaire is to provide information which can be used to evaluate how actual practices for crafts, applied arts, technology education, industrial arts or career education are used in elementary grades.

I am requesting this information from you because in the summers of 1980-81 you participated in an Industrial Arts and Career Education Workshop for Elementary Teachers. Realizing how busy you are, the questionnaire is intentionally brief and should take about fifteen minutes to complete.

Please complete the enclosed questionnaire and return it in the self-addressed, stamped envelope by May 15. This information is being gathered for statistical purposes only and will be kept confidential. If you have any questions regarding this research, please feel free to call me at (515)233-6887 or 294-8529. Thank you for your time and cooperation.

Sincerely

Alfred A. Hart III
Graduate Student
Iowa State University

Dr. William D. Wolansky
International Education Program
College of Education
Iowa State University
(Professor in Charge of Study)