# Analysis of curriculum patterns in middle school technology education in Bozeman, Montana

by Karen Patrice Campbell

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Education
Montana State University


Abstract:
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These curriculum patterns were compared with the Content Standards in Technology Education in the Bozeman Public Schools: K-8 Curriculum in order to determine alignment. Other findings emerged as worthy of note, including evidence of Curriculum Integration, Limited Student Work Time, and Videotaping. The Technology Education curriculum in both middle schools was consistent with the factors of technological literacy presented in the literature on the subject; and with the goals of the International Technology Education Association and the Technology Education Association of Montana.

# ANALYSIS OF CURRICULUM PATTERNS IN MIDDLE SCHOOL TECHNOLOGY EDUCATION IN BOZEMAN, MONTANA

by

Karen Patrice Campbell

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APPROVAL

of a thesis submitted by

Karen Patrice Campbell

This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

Kenneth Bruwelheide — June 15, 1998

Dr. Kenneth Bruwelheide — Date
Chairperson, Graduate Committee

Approved for the Major Department

Gloria Gregg — 6/25/98

Dr. Gloria Gregg — Date
Head, Major Department

Approved for the College of Graduate Studies

Joseph J. Fedock — 7/10/98

Dr. Joseph J. Fedock — Date
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Date July 4, 1998

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ABSTRACT

Using qualitative research methodology, programs of Technology Education were studied in two middle schools in Bozeman, Montana, in order to identify curriculum patterns. The patterns that emerged were Hands-On Activities, Problem Solving, Career Readiness, and Self-Directed Learning. These curriculum patterns were compared with the Content Standards in Technology Education in the Bozeman Public Schools: K-8 Curriculum in order to determine alignment. Other findings emerged as worthy of note, including evidence of Curriculum Integration, Limited Student Work Time, and Videotaping. The Technology Education curriculum in both middle schools was consistent with the factors of technological literacy presented in the literature on the subject; and with the goals of the International Technology Education Association and the Technology Education Association of Montana.

# CHAPTER 1

## INTRODUCTION

Students of the 1990s are faced with a world which is changing constantly and rapidly. Technology is an integral component of this change, as both a cause and resultant force of societal evolution. Dugger and Yung (1995) asserted:

> Because we interact daily with technology and must make important decisions concerning its development and application, citizens must know about technology, have an appreciation of its advantages and disadvantages, and be able to use technology as an extension of human potential. Thus, technology education is evolving as an essential subject in the schools. (p. 7)

Technology education is, therefore, an important basic subject which must be taught to all children if they are to thrive in today's modern world. Peterson (1986) stated that "because of the important relationship which exists between culture and technology, the . . . school that prepares students to understand and live successfully within their culture must include technology-based content" (p. 47). We must begin to educate youngsters in technology and its systems at an early age because, as Bottrill (1995) revealed, "technological activity works best when there is a program of progression through the elementary school" (p. 6). Technology education is most effectively taught as a core subject from kindergarten through twelfth grade, in addition to traditional academic subjects (Dugger & Yung, 1995). Because they then experience an awareness of the basic components of the discipline, children grow to progressively master the components of technology and its influence on the individual, society, and the environment. "Through the exploration of technology in an integrated manner . . . children can attain a better understanding of technology and its impacts, thus becoming technologically literate citizens" (Ortega & Ortega, 1995, p. 11).

It is this application of technological processes, skills, and tools that gives youth a realistic perception of the world in which they live. Benson and Raat (1993) stressed that technology should be approached in an activity-based way through creatively solving problems and making useful things. According to Pagliari (1995), "Technology educators seem to realize that technology education should no longer be confined to secondary education. This realization must be communicated to educators at all levels" (p. 3).

Due to the changing manner in which work has been perceived and conducted in the recent past, education has also been stimulated to reevaluate its role in producing young adults who can compete successfully in the work place. Johnston (1993) stated:

> During the past decade, attempts to respond to perceived economic crisis have dominated educational reform. . . . In brief, the reform argument is that the United States economy is suffering from a crisis of low productivity and competitiveness and may be attributed primarily to inadequate educational preparation among future members of the labor force. (p. 40)

This statement suggests that past educational strategies may no longer meet the needs of the new job site which is often based on facilities and equipment that are highly technological in nature. Gordon (1993, p. 7) revealed, "The introduction of complex computer technology and other high-tech innovations into every office and plant has left a staggering number of younger and older workers in danger of becoming the undereducated 'new peasants' of the Information Age."

Not only has education been under scrutiny for lack of technological preparation of students, but also because the fundamental skills which it has traditionally imparted are not directed towards the environment in which students find themselves upon graduation. In fact, "the primary educational need may be to inculcate among students the attitudinal and cognitive skills required to constantly readapt to changing social and economic conditions" (Johnston, 1993, p. 46). These varying circumstances require an adjustment in the schools. As Blakemore (as cited in National Academy of Sciences, 1995) noted:

> In the information age, the human beings that industry needs are those who can do their own thinking, get actively involved, work in teams, and be innovative, not merely industrious. The trouble is, the factory model school, which doesn't encourage those qualities, is still with us and needs to be replaced with a new kind of schooling that does. (p. 5)

American education has not yet adapted to this new set of expectations. The Secretary's Commission on Achieving Necessary Skills (SCANS) (1992) determined that, in order for young people to be successful in the work world, they must have new types of skills. According to the report (SCANS, 1992) detailing those required abilities,

> Effective workers can productively use:
>
> - Resources--They know how to allocate time, money, materials, space and staff.
> - Interpersonal skills--They can work on teams, teach others, serve customers, lead, negotiate, and work well with people from culturally diverse backgrounds.
> - Information--They can acquire and evaluate data, organize and maintain files, interpret and communicate, and use computers to process information.

- Systems--They understand social, organizational, and technological systems; they can monitor and correct performance; and they can design or improve systems.

- Technology--They can select equipment and tools, apply technology to specific tasks, and maintain and troubleshoot equipment. (p. xiv)

If education is to rise to these new standards, it must endorse the future that technology helps shape. Technology education must therefore be addressed in the schools. As Dugger and Yung (1995) acknowledged:

> Technology has become a powerful force in everyday life. Humans have the ability and responsibility to use technology to create an even better future. In order to do this, teachers must educate future citizens now to be technologically aware, literate, and capable. These three levels of technology education are keys to that better global future. (p. 20)

Curriculum restructuring may play a role in the producing technological literacy. Technology education, according to Peckham (1989), has traditionally used a variety of curricular methods to bridge academic knowledge and its application in preparing students to function as "knowledgeable citizens in our increasingly technological world" (p. 15). According to Lewis (1992), however, curriculum delineation of technology education has been lacking since it separated from the field of industrial arts. Differences in philosophy and practice have resulted in inconsistency. Wicklien (1993) noted that the research reveals a lack of consensus on curriculum as one of the major problems now facing the discipline.

## Statement of the Problem

Technology Education in the Bozeman Public Schools: K-8 Curriculum (Bozeman School District, 1994) identifies curriculum strands in technology education at the middle school level in Bozeman, Montana (see Appendix M). This study results from the fact that the author has found no qualitative work in the literature which attempts to reveal curriculum patterns in middle school technology education in Bozeman, Montana.

## Purpose of the Study

The purpose of this study was to analyze curriculum patterns in technology education at the middle school level in Bozeman, Montana.

## Limitations

1. The study was limited to two Bozeman, Montana, middle school classrooms and the two teachers in those classrooms currently using technology education.
2. The teachers were current members of the Technology Education Association of Montana and were endorsed in

Technology Education by the Montana Office of Public Instruction.

3. The study was conducted during the 1996-97 school year.

## Definition of Terms

The following terms were defined for this study:

**Artifact:** "A characteristic product of human activity" (Webster's Ninth New Collegiate Dictionary, 1985, p. 105).

**Curriculum:** "The planned curriculum is an educational response to the needs of society and the individual, and requires that the learner construct knowledge, attitudes, values, and skills through a complex interplay of mind, materials, and social interactions" (Erickson, 1995, p. 33).

**Educational technology:** "The instructional hardware and techniques that enable one to enhance classroom presentations and the methodology behind their use" (K. Bruwelheide, personal communication, December 14, 1995).

**Qualitative Research:** "Qualitative methods permit the evaluator to study selected issues in depth and detail. . . . Qualitative methods typically produce a wealth of detailed information about a much smaller number of people and cases [than quantitative methods]. This increases understanding of the cases and situations studied but reduces generalizability" (Patton, 1990, pp. 13-14).

**Quantitative Research:** "Quantitative methods . . . require the use of standardized measures so that the varying perspectives and experiences of people can be fit into a limited number of predetermined response categories to which numbers are assigned. . . . This gives a broad, generalizable set of findings presented succinctly and parsimoniously" (Patton, 1990, pp. 13-14).

**Technological literacy:** "An understanding of technology and its dynamics, the opportunities it offers, its impact on products and processes, markets, organizational structure and people" (International Technology Education Association, 1985, cover).

**Technology:** "The systematic application of ideas, tools, materials, and other resources to produce outcomes in response to human wants and needs" (Montana State University Department of Technology Education, 1994, p. 5).

**Technology education:** "An educational program that helps people develop an understanding and competence in designing, producing, and using technology products and systems" (Bottrill, 1995, p. 41).

**Triangulation:** "Using multiple investigators, multiple sources of data, or multiple methods to confirm the emerging findings" (Merriam, 1998, p.204).

## Research Questions

This goal of the study was to answer the following research questions:

1. What curriculum patterns currently exist in middle school technology education classrooms in Bozeman, Montana, as revealed through:
   - Classroom observations
   - Audio taped class lectures
   - Videotaped class sessions
   - Classroom artifacts (teaching materials and student work)
   - Photographs of classroom facilities
   - Formal student interviews
   - Formal teacher interviews

2. How do the identified curriculum patterns align with the curriculum expressed in Technology Education in the Bozeman Public Schools: K-8 Curriculum?

## Methodology

### Data Collection

The researcher used a qualitative methodology in the case study format (Bogdan & Biklen, 1992) for this study because it appeared to be the most effective way to gather data and effect constructive change with local middle school technology education programs. Borg and Gall (1989, pp. 406-407) revealed that qualitative methods are best at finding answers to the following five questions:

1. What's happening in the field setting?
2. What do the happenings mean to the people involved in them?
3. What do people have to know in order to be able to do what they do in the setting?
4. How does what is happening here relate to what is happening in the wider social context of this setting?
5. How does the organization of what is happening here differ from that found in other places and times?

Qualitative research methodology is especially useful for defining important factors such as patterns which exist in education. Borg and Gall (1989, p. 408) stated:

> In many areas of education we have only a very sketchy understanding of the variables that relate to important educational outcomes. . . . Because of their emphasis upon holistic longitudinal approaches and efforts to maintain a nonjudgmental orientation, qualitative researchers have the

> potential for discovering new variables that have been overlooked by quantitative researchers.

The researcher employed multiple methods of data collection in this study to provide cross referencing of data. Several different data sources were then triangulated in order to reinforce researcher observations and enhance validity (Goetz & LeCompte, 1984). Borg and Gall (1989) explained that triangulation is a way to assist the qualitative researcher to focus on different facets of a situation which is too complex to study in its entirety. They stated:

> A partial solution to understanding this complex reality is <u>triangulation of methodology</u>, that is, using several methods to study the same object. . . .Triangulation can also be achieved by collecting essentially the same data from different samples, at different times, and in different places. In this sense, triangulation is simply a form of replication that contributes greatly to our confidence in the research findings regardless of whether qualitative or quantitative methodology has been employed. (p. 373)

The researcher accomplished the study using the following data collection methods, which will be explained in detail in Chapter 3:

1. Field observations.
2. Audio taped class lectures.
3. Videotaped classes.
4. Classroom artifacts.
5. Photographs of classroom facilities.

6. Formal teacher and paraprofessional teacher interviews (See Appendices E and F).
7. Formal student interviews (See Appendix D).

Data Analysis

The researcher gleaned information from observations, formal interviews, audiotapes and videotapes, and documented records by consistently developing correspondences between data sources. She then compared and analyzed the data to develop and corroborate research findings utilizing methodology from Patton (1990, pp. 369-494). Categories of curricular patterns were identified, and teacher and student comments were catalogued, in order to delineate existing curricular themes. Final analysis produced a shared alignment of curriculum patterns with those stated in Technology Education in the Bozeman Public Schools: K-8 Curriculum.

## Summary

Constant rapid change in the technological world in which we live has produced a need for individual mastery of technology and its use, both socially and in the world of work. The discipline of technology education may help to give students the tools they need to become technologically literate citizens (Ortega & Ortega, 1995).

This study analyzed technology education programs in two Bozeman, Montana, middle schools. The researcher used qualitative methodology for data collection and data analysis in order to identify curriculum patterns. These patterns were then compared with the standards set forth in _Technology Education in the Bozeman Public Schools: K-8 Curriculum_.

# CHAPTER 2

# REVIEW OF THE LITERATURE

## Introduction

The American educational system has historically presented students with the tools of general knowledge required to be successful in life. Technology education has a unique place in the system of general education because it is basic to mastery of the constantly changing elements of our technological society. This chapter presents a review of the literature that reveals two perspectives of technology education:

1. A 20th century historical overview.
2. Salient curricular themes.

## Historical Overview of the 20th Century

Technology education can trace its history from the manual training of the 19th century to the discipline of industrial arts to the field of contemporary technology education (Zargari & MacDonald, 1994). In the interest of brevity, only the history of technology education in the 20th century will be examined herein.

In 1923, a work entitled Industrial Arts for Elementary Schools was published by Professors F. G. Bonser and L. C. Mossman of Teachers College at Columbia University. Foster (1995) revealed that, at the time, "The rationale for cultural industrial education was that children need to learn about technologies of the home and of commercial industry to understand their increasingly technological world" (p. 64). In that work, the first definition of industrial arts was coined (Foster, 1995). According to Bonser and Mossman (1923), "Industrial arts is a study of the changes made by man in the form of materials to increase their values, and of the problems of life related to these changes" (p. 5). Industrial arts as a discipline thus seemed to have become the conceptual parent of what is now known as technology education. As Foster (1995) stated, for the first time, "Bonser and Mossman, along with Teachers College Dean James E. Russell . . . developed a comprehensive system of industrial education which, although never implemented on a large scale, has been the theoretical basis for technology education for most of the past seventy years" (p. 47).

In the era following World War II, Martin and Luetkemeyer (1979) credit G. Wilbur as having written the "basic text for professional courses in industrial arts teacher education" (p. 35) in 1948. This book, Industrial Arts in General Education, was said by them to have been "used by colleges throughout the country" (Martin & Luetkemeyer, 1979, p. 35). Some years then passed before industrial arts moved towards a stated concept of technology as a necessary development in the field. In 1963, Delmar Olson of The Ohio State University published Industrial Arts and Technology which Dugger and Yung (1995) stated "stressed the challenge of technology as a source for students' discovery and development of native aptitudes and creative applications in the field of industrial arts education" (p. 15). Soon afterward, in 1964, Paul W. DeVore's monograph, Technology: An Intellectual Discipline, firmly overturned the previously laid structure for the discipline. This work may have been the beginning of what is perceived by some to be the new paradigm of technology education. "It laid the foundation for technology as the organizing framework for curriculum, superseding the previous industrial framework that had been used for industrial arts curricula" (Dugger & Yung, 1995, p. 15).

The year 1973 saw the creation of The Maryland Plan by D. Maley. For the first time, technology was included in a definition of industrial arts (Foster, 1994). Maley (1973) stated that industrial arts was "those phases of general education which deal with technology, its evolution, utilization, and significance; with industry, its organization, materials, occupations, processes, and products; and with the problems and benefits resulting from the technological nature of society" (p. 2). Then, in 1976, DeVore and Lauda (1976) suggested a formal name change from industrial arts to technology education.

The publication of Jackson's Mill Industrial Arts Curriculum Theory in 1981 further defined the term "industrial arts" in a broader theoretical and practical way (Foster, 1994) by giving detailed examples of ways in which technology could be taught. As Rogers (1995) stated:

> The Jackson's Mill Industrial Arts Curriculum Theory . . . provided specific examples of how technology education should provide an articulated program of study from elementary technology education to introductory technology education courses in middle school to high school specialization courses. (p. 59)

## Contemporary Development of Technology Education

The formal name change finally came three years later when, as Dugger and Yung (1995) revealed: "In 1984, the AIAA

[American Industrial Arts Association] members voted to change the organization's name to the International Technology Education Association (ITEA), effective in March, 1985" (p. 17). That organization then issued this definition of technology education: "A comprehensive, action-based educational program concerned with technical means, their evolution, utilization, and significance; with industry, its organization, personnel systems, techniques, resources, and products; and their socio-cultural impacts" (American Industrial Arts Association [AIAA], 1985, p. 25). More recently, in 1988, Technology Education: A National Imperative was published by the International Technology Education Association as an important document signaling the transition towards the discipline of technology education (Dugger & Yung, 1995).

The International Technology Education Association became a leading professional body for technology educators. The 1994-95 ITEA Strategic Plan (International Technology Education Association [ITEA], 1994a, p. 1) stated ITEA's mission in the following way: "ITEA promotes excellence in technology teaching and works to increase the effectiveness of educators to empower all people to understand, apply, and assess technology." Its vision as an association was to:

- Position technology as a basic area for academic study.

- Provide leadership in developing curriculum.
- Support teachers in implementing their programs.
- Enhance participation of minorities and women in technology. (p. 1)

These goals have been implemented in the discipline. In Technology Education: Changing The Way We Think (ITEA, 1994c), technology education goals were stated in terms of curricular focus:

> As part of the school curriculum, Technology Education teaches students to understand, use and control technology. The curriculum covers the development of technology and its effect on people, the environment and society. Students learn how to adjust to change, to deal with forces that influence their future and to participate in controlling their future. (p. 2)

In Technology Education and Your Child, ITEA (1994b) noted that students at the middle school level should:

- Develop an appreciation of the scope of contemporary technology.
- Study and analyze the materials, products, processes, problems, uses, developments, and contributions of technology.
- Research, plan, design, construct, and evaluate problems and projects common to technological career fields.
- Identify occupational fields and education programs in technological career fields.
- Experience the organization and management systems of business and industry.

- Learn safe use of basic tools, machines, materials, and processes associated with technology. (pp. 1-2)

Technology Education at the Local Level

ITEA expanded its support into state organizations, which then took the mandate to disseminate the philosophy and implementation of technology education at the state level (K. Bruwelheide, personal communication, June 27, 1997). The state affiliation for ITEA in Montana is the Technology Education Association of Montana (TEAM), which was instrumental in the development of Technology Education in the Bozeman Public Schools: K-8 Curriculum through the membership of its Bozeman, Montana, teachers (K. Bruwelheide, personal communication, June 27, 1997). This document was developed in response to a need to provide continuity in technology education between elementary and middle schools at the K-8 levels, and is in alignment with the goals and mission of ITEA (K. Bruwelheide, personal communication, June 27, 1997). The Mission Statement of Technology Education in the Bozeman Public Schools: K-8 Curriculum (Bozeman School District, 1994, p. 3) stated:

> We believe that for the students of Bozeman Public School District #7 to become well informed, productive citizens of the world today, and the world of the future, they must possess the concepts and basic skills necessary to function in a technology-based society. Therefore, it [is]

> the mission of the Technology Education curriculum to provide, promote and facilitate technological literacy, career awareness and occupational preparation among the students attending Bozeman Schools.

Curricular areas which were addressed included Technology Education, Educational Technology, and Computer Literacy (Bozeman School District #7 Technology Committee, 1994). Names of existing teachers and administrators who played an integral part of this process may be found in Appendix M.

## Curriculum Trends

Referring to developments in the 1990s, Waetjen (1989) stated, "The last decade has witnessed a startling change in what was once Industrial Arts Education and has now evolved into Technology Education. The evolution has been more than cosmetic, and far more than a simple change of names" (p. 1). Dugger and Yung (1995) felt that a major influential document in the decade so far is A Conceptual Framework for Technology Education by Savage and Sterry, published in 1990. Growth in technology education can also be seen in the definition of technology education issued by Wright, Israel, and Lauda (1993) in A Decision-makers Guide to Technology Education as "an educational program that helps people develop an understanding and competence in designing, producing, and using technology products and systems and in assessing the appropriateness of technological actions" (p. 4).

Recent collaborative ventures with the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF) have also done much to promote interest in the discipline. As Mino (1995) revealed, in speaking of the recent (1994) Technology for All Americans Project, "The ITEA has joined forces with NASA and the NSF to present American education with perhaps the greatest challenge it has faced since the beginning of the space race" (p. 3). This project is divided into two stages. As Satchwell and Dugger (1995) stated:

> The goal for phase one of this project is to develop a long-term vision for what the intellectual domain for technology education should be. . . . The second phase of this project will seek funding to continue this efforts so that the profession can develop, validate, and gain national consensus on the Standards for curriculum content in technology education (p. 93).

Technology education's status is both hopeful and presented with problems. The evolution of the discipline has also been somewhat sporadic. Zuga (1994) noted, in reference to its growth, "Over the years what is practiced as technology education has continued to evolve, making the precise definition of the field a moving target" (p. 1). It is the work of those within the field to assist it in its development. Dugger and Yung (1995) acknowledged that, to date, "the future of technology education in the United States . . . is bright. However, much work still needs to be done to refine philosophies and curricula, to provide quality education for new and current technology teachers, and to research emerging technologies that future programs will need to address" (p. 19).

## Salient Curricular Themes

Several content strands currently pervade the paradigm of technology education. The educators mentioned in the following discussion noted patterns of activity orientation, problem-solving, career preparation, and self-directed learning as significant curricular themes.

### Activity Orientation

Peckham (1989) revealed that technology education commonly uses hands-on "activity-oriented lab instruction with students reinforcing abstract concepts with concrete experiences" to produce "a combined emphasis on 'know-how' and 'ability to do' in carrying out technological work" (p. 17). At the middle school level, she noted, these activities "result in technological awareness, psychomotor development, and awareness of the development, impact, potential, and careers related to technology" (p. 17). The educational theory of constructivism states that meaningful learning may occur when students incorporate prior knowledge of the world with active discovery of concepts and facts (Wright & Foster, 1996). Technology education often uses project-based instruction to help create such knowledge. Because technology education employs the constructivist approach to teaching, it creates . . . "a learning environment where students are actively involved in building knowledge about their physical world through practical activities" (Bottrill, 1995, p. 10).

Problem Solving

Problem solving is a consistent theme in the technology education curriculum. Benson and Raat (1993) stressed that technology should be approached through creatively solving problems and making useful things. At the same time, the world of work is increasingly making changing demands on education. As Cook (1992) revealed: "A student cannot afford to miss problem solving skills. Employers of today and the future are constantly asking educators to include more critical thinking skills when teaching students" (p. 12).

Cano and Martinez (1991) found that the use of problem-solving in the classroom had a significant increase on critical thinking and cognitive abilities. These abilities are essential to educating students to function effectively in our technological society. As Bottrill (1995) stated:

> Changes in the nature of education . . . are having an effect on . . . attitudes to teaching and learning in the schools. These goals involve the development of creative thinking, decision-making and problem-solving, seeing things in the mind's eye, knowing how to learn, reasoning and the development of personal qualities. (p. 44)

Career Preparation

Developing skills that prepare students to enter the work force after graduation was seen as desirable by The Secretary's Commission on Achieving Necessary Skills (SCANS, 1992). They stated, "The nation's schools must . . . be transformed into high-performance organizations" (p. 19). According to SCANS (1992, p. 81), a competent worker is one who:

> **Manages Time**--Selects relevant, goal-related activities, ranks them in order of importance, allocates time to activities, and understands, prepares, and follows schedules.
>
> **Participates as a Member of a Team**--Works cooperatively with others and contributes to group efforts with ideas, suggestions, and effort.
>
> **Negotiates to Arrive at a Decision**--Works towards an agreement that may involve exchanging specific resources or resolving divergent interests.

The employee must also exhibit certain personal qualities, among which are:

**Responsibility**--Exerts a high level of effort and perseverance toward goal attainment; works hard to become excellent at doing tasks by setting high standards, playing attention to details, working well even when assigned an unpleasant task, and displaying a high level of concentration; and display high standards of attendance, punctuality, enthusiasm, vitality, and optimism in approaching and completing tasks.

**Self-Management**--Accurately assesses own knowledge, skills, and abilities; sets well-defined and realistic personal goals; monitors progress toward goal attainment and motivates self through goal achievement; and exhibits self-control and responds to feedback unemotionally and nondefensively. (SCANS, 1992, p. 84)

Jobs of the future require workers that have a unique combination of technical and academic skills. Deal (1994, p. 14) revealed that companies of today ". . . are looking for people that have good technical and communication skills and backgrounds in math, science and technology, and the ability to solve problems." Technology education may offer students the opportunity to develop these qualities. As Volk (1995) stated, "Technology education provides meaningful experiences which clearly illustrate the importance of group interaction, employability and personal development skills" (p. 38).

Self-Directed Learning

The requirements of modern technological society have produced a need for workers to be more motivated and self-sufficient. Blakemore (as cited in National Academy of Sciences, 1995) revealed that, "In the information age, the human beings that industry needs are those who can do their own thinking" (p. 2). According to Stevens (1986), productive citizenship requires the capacity for independent thought. Self-motivation and self-direction are essential for decision-making and innovation. According to Berryman (1992), students also need cognitive learning strategies to function effectively in any setting. These include "learning how to learn, including exploring new fields, getting more knowledge in a familiar subject, and reconfiguring knowledge already possessed" (p. 4).

Webster's Dictionary (1985) defines "resource" as the "ability to meet and handle a situation" (p. 1004). In the context of the technology education classroom, it points to the capacity of students to find information on their own in order to solve problems or meet individual needs. Anderson (1996) stated that:

> It is no longer possible for teachers to know or teach everything a student needs to know to succeed in life. In all areas of the curriculum we must teach an information-based inquiry process which meets the demands of this new age. This is the new challenge for the world's most important profession. (p. 2)

Self-directed learning must, therefore, include the student's ability to locate and use resources independently of the teacher.

## Summary

From the review of the literature one can determine the historical importance and future necessity of technology education. From its source in 19th century manual training through its evolution as industrial arts into 20th century technology education (Zargari & MacDonald, 1994), the field has concerned itself with hands-on mastery of technology. As a recent discipline, it advocates student understanding, use, and control of technology in today's changing world (ITEA, 1994b).

Curriculum strands reflecting the needs of the 1990's have found their way into the technology education classroom. The major emphasis of technology education is to develop technological literacy through a focus on areas such as activity orientation, problem-solving, career preparation, and self-directed learning.

# CHAPTER 3

# METHODOLOGY

## Overview of Qualitative Research

### Introduction

The researcher employed the qualitative method in this study because educational programs and the people involved were the objects of research. The qualitative paradigm primarily focuses on individual lives, personal behaviors, societal factors, structure within organizations, and relationships (Gloeckner & Gerst, 1994). The researcher chose qualitative techniques to describe middle school students and their teachers. These methods permit deep and detailed study of human issues with little attention to generalizing the results (Patton, 1990).

Middle school technology education classes were the environment for this study. The qualitative paradigm is particularly appropriate for research in an educational environment (Borg & Gall, 1989). Gloeckner & Gerst (1994) revealed: "Qualitative research uses a natural setting such as intact technology classrooms. It seeks to describe and understand relationships in a natural setting without attempting to manipulate variables" (p. 33).

The qualitative researcher often interacts closely with those involved in the study because perceptions and feelings are the elements of interest and: "The only way to get an accurate understanding of these internal states . . . is to form a personal relationship with those being studied" (Borg & Gall, 1989, p. 24). The researcher used personal contact as the means to collect data throughout this study.

The researcher also recorded and analyzed what took place in the classroom and therefore played a unique role. Guba & Lincoln (1988) revealed that those conducting the study are considered to be the research instruments. The final written product thus incorporated this subjective presence. Borg & Gall (1989) acknowledged the researchers' role in the formation of study results:

> They rely partly on their feelings, impressions, and judgments in collecting data. They also rely heavily on their own interpretations in understanding the meaning of their data. Their findings often are reported in the form of verbal descriptions . . . Rather than in the form of quantitative summaries of the type yielded by statistical analysis. (p. 23)

The final product, therefore, is often written with the use of narrative. Smith (1982, p. 628) asserted that study results are likely to emerge as ". . . descriptive patterns, hypotheses, perhaps theory, or even 'a story.'" The author of this study used narrative to present the study data, some of which consisted of student and teacher interviews.

Philosophical Perspectives

The direction taken by research is considered to be defined by the philosophical paradigm upon which it is based. As Meyers (1997, paragraph 16) stated: All research ". . . is based on some underlying assumptions about what constitutes 'valid' research and which research methods are appropriate." Research has historically revolved around two competing models. Borg and Gall (1989) noted that qualitative research assumes a naturalistic stance and quantitative research is based on a model of positivism. The naturalistic model approaches the subject or phenomenon in a holistic way and makes no attempt at generalization (Patton, 1990).

Qualitative Research Methodology

"A research method is a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection" (Meyers, 1997, paragraph 22). Borg & Gall (1989) note the Case Study as a methodology commonly employed in the field of education.

Case studies have been used in many diverse disciplines in the past. Borg, Gall, & Gall (1993) noted that: "They are being conducted increasingly in education as researchers have become more interested in studying complex educational phenomena in this context" (p. 202). The case study focuses on one site, program, or individual in order to reveal meaning. "Unlike the experimenter who manipulates variables to determine their causal significance. . . , the case study researcher typically observes the characteristics of an individual unit--a child, a clique, a class, a school or a community" (Cohen & Manion, 1985, p. 120). He or she then discovers patterns during and after thorough investigation of the phenomenon. "In most forms of case studies, the emerging themes guide data collection, but formal analysis and theory development do not occur until after the data collection is near completion (Bogdan & Biklen, 1992, p. 72). This qualitative study uses the case study methodology.

Researcher's Pre-Study Experiences

The researcher earned a Bachelor of Science degree in Technology Education in August, 1995, from Montana State University, Bozeman, Montana. She had spent the prior ten years working in the manufacturing industry as an automation mechanic apprentice, an assembler, a research technician, and a quality assurance technician.

The researcher also worked in the study classroom(s) before initiating this research. During September and

October, 1994, she completed 32 hours of paraprofessional experience in the Chief Joseph Middle School technology education classroom, where the teachers involved in this study team taught grades 6-8. The researcher also spent ten weeks as a participant observer student teaching with John Hickey in grades 6 and 8, and observing Glen Rintamaki in grade 7; during the months of January, February, and March, 1995. Prior to the beginning of this study, the researcher had spent approximately 232 hours in these classrooms.

Data Collection

Permission to undertake this study was granted in February, 1997, by Bozeman Public Schools. Letters seeking and granting approval are included in Appendix N. All data for this study were collected between February 21 and May 1, 1997.

Patton (1990, p. 244) stated that, in qualitative inquiry:

> Multiple sources of information are sought and used because no single source of information can be trusted to provide a comprehensive perspective on the program. By using a combination of observations, interviewing, and document analysis, the field-worker is able to use different data sources to validate and cross-check findings.

In this study, multiple methods of data collection were used to cross-validate information.

Referring to the types of data collected in qualitative research, Bogdan & Biklen (1992, p. 106) also noted that:

> Data include materials the people doing the study actively record, such as interview transcripts and participant observation field notes. Data also include what others have created and the researcher finds, such as diaries, photographs, official documents, and newspaper articles.

The data collected in this study consisted of field observations, audio taped class lectures, videotaped class lectures, classroom artifacts, photographs and drawings of classroom apparatus, formal student interviews, and formal teacher interviews. Appendix A contains a detailed data collection summary in chronological order.

1. Field Observations - Eight days were spent in the middle schools: 5 days at Sacajawea; 3 days at Chief Joseph. Technology education students and teachers were observed for a total of 18.5 hours in the two classrooms: 13.6 hours at Sacajawea; 4.9 hours at Chief Joseph. (The observation instrument used for class visits is included in Appendix B.) All observations are listed in Table 1.

Table 1. Technology Education Classroom Observations.

| GRADE LEVEL | SACAJAWEA MIDDLE SCHOOL | CHIEF JOSEPH MIDDLE SCHOOL | TOTAL CLASSES BY GRADE |
|---|---|---|---|
| Grade 6 | 6 Classes | 3 Classes | 9 Classes |
| Grade 7 | 6 Classes | 4 Classes | 10 Classes |
| Grade 8 | 6 Classes | 3 Classes | 9 Classes |
| | | TOTAL CLASSES OBSERVED | 31 Classes |

2. Audio taped Class Lectures - Three of the observed class lectures at Sacajawea Middle School were Audio taped, producing 2.4 hours of audiotape. These tapes were transcribed verbatim for analysis.
3. Videotaped Classes - Three of the observed class periods at Chief Joseph Middle School were videotaped, resulting in 1.8 hours of videotape.
4. Classroom Artifacts - 41 classroom artifacts were compiled from both classrooms: 20 class assignment sheets (such as "Making a Styrofoam Puzzle" and "How Stuff Works"), 10 classroom instructions (6th, 7th, and 8th grade activities lists), and 10 examples of student work (such as patent designs for Rube Goldberg devices and bridge designs). Examples are found in Appendix C.
5. Photographs - 92 photographs of both classrooms were taken depicting work stations and equipment.

6. Formal Teacher Interviews - One hour interviews were done with each of the two teachers: John Hickey, Sacajawea Middle School; and Glen Rintamaki, Chief Joseph Middle School. The interviews were audiotape recorded and transcribed verbatim for analysis. Classroom teacher interview questions are included in Appendix E. A Montana State University paraprofessional technology education student who had spent approximately 32 hours fulfilling his paraprofessional teaching requirement in John Hickey's classroom was also interviewed for 30 minutes. The interview was audiotape recorded and transcribed verbatim for analysis. Interview questions for the paraprofessional teacher are included in Appendix F.

7. Formal Student Interviews - 37 students in grades 6-8 were interviewed individually for 5-10 minutes each, resulting in 4.5 hours of student interview time (see Table 2). In all classes except one in which interviews were conducted, two male and two female students were interviewed. In the remaining class, three females and one male student were interviewed. This produced a total of 19 female and 18 male students interviewed. These interviews were conducted during 18 of the 31 observed classes. All interviews were

audiotape recorded and transcribed verbatim for analysis. Interview questions are included in Appendix D.

Table 2. Formal Student Interviews.

| GRADE LEVEL | SACAJAWEA MIDDLE SCHOOL | | CHIEF JOSEPH MIDDLE SCHOOL | | TOTAL SCHOOL INTERVIEWS | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| 6th | 4 | 4 | 2 | 2 | 6 | 6 |
| 7th | 4 | 4 | 2 | 2 | 6 | 6 |
| 8th | 4 | 5 | 2 | 2 | 6 | 7 |
| TOTAL | 12 | 13 | 6 | 6 | 18 | 19 |

## Data Analysis

### Curriculum Pattern Identification

The researcher identified curriculum patterns through comparative pattern analysis (Patton, 1990) using the observations, transcribed audio taped class lectures, videotaped class sessions, classroom artifacts, transcribed student interviews, and transcribed teacher interviews. Patton described the technique of comparative pattern analysis:

> The evaluator-analyst begins by looking for "recurring regularities" in the data. These regularities represent patterns that can be sorted into categories. . . . The naturalistic evaluator then works back and forth between the data and the classification system to verify the meaningfulness

> and accuracy of the categories and the placement of data in categories. (p. 403)

The author formulated results through triangulating the multiple data sources. As Patton (1990, p. 467) noted: "This means comparing and cross-checking the consistency of information derived at different times and by different means within qualitative methods." Observations were compared with interviews, interviews with classroom artifacts, and artifacts with video and audiotapes, in order to verify the consistency of the identified patterns. The frequency of regularly occurring patterns was then documented and translated into percentages based on the number of data collected. These percentages were expressed in tables 5 and 6 in Chapter 4 and Appendices H-L. Quotations, where applicable, were identified as evidence of reported patterns.

Curriculum Pattern Alignment

Curriculum patterns evolved from the application of Content Standards from Technology Education in the Bozeman Public Schools: K-8 Curriculum in the classroom. The extent to which these patterns aligned with the stated Content Standards is summarized in Appendices G-L.

Other Findings

Additional findings surfaced which did not relate to curriculum patterns. These other findings were important because of consistency of repetition in the data. Summaries of percentages of data in curriculum patterns and other findings based on observations, classroom artifacts, photographs and drawings, student perceptions, and teacher perceptions are contained in Appendices H-L.

## Summary

This study is grounded in the naturalistic stance of qualitative research and case study methodology. It examines the educational environment of two middle school technology education classes in order to reveal curriculum patterns and their relationship to the Content Standards stated in Technology Education in the Bozeman Public Schools: K-8 Curriculum. The researcher employed multiple methods of data collection and analyzed the data in a process of comparative pattern analysis using triangulation of data sources. The results were then presented using interview quotes, observed classroom actions, and document analysis.

# CHAPTER 4

# FINDINGS

## Introduction

The findings which were produced which were classified in the following categories:

1. Curriculum patterns which surfaced as a result of comparative data analysis.
2. Curriculum pattern alignment with Content Standards 1-5 from Technology Education in the Bozeman Schools: K-8 Curriculum.
3. Other findings which emerged but did not fit within the
4. category of curriculum patterns.

## Educational Setting

The technology education classes at both middle schools lasted a period of six weeks, called a "rotation." At the end of this period a new group of students entered technology education classes. This study was conducted during the fifth and sixth weeks of one technology education class rotation; and during the first week of the next class rotation, for both Sacajawea and Chief Joseph Middle Schools. At Sacajawea Middle School, data gathering for weeks five and six of the first rotation occurred between February 21 and March 3, 1997; data gathering for the first week of the second rotation was conducted on March 11, 1997. For Chief Joseph Middle School, data gathering for weeks five and six of the first rotation was conducted on April 15 and April 21, 1997; and on May 1 for week one of the second rotation. Table 3 shows the weeks (marked by an "X") during which research was conducted.

Table 3. Research Study Weeks.

| 1ST ROTATION | | | | | | 2ND ROTATION | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | ROTATION WEEK | 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | X | X | Sacajawea Middle School | X | | | | | |
| | | | | X | X | Chief Joseph Middle School | X | | | | | |

The six-week rotations were marked by varying degrees of three main types of instruction:

- Lecture
- Demonstration
- Student Work

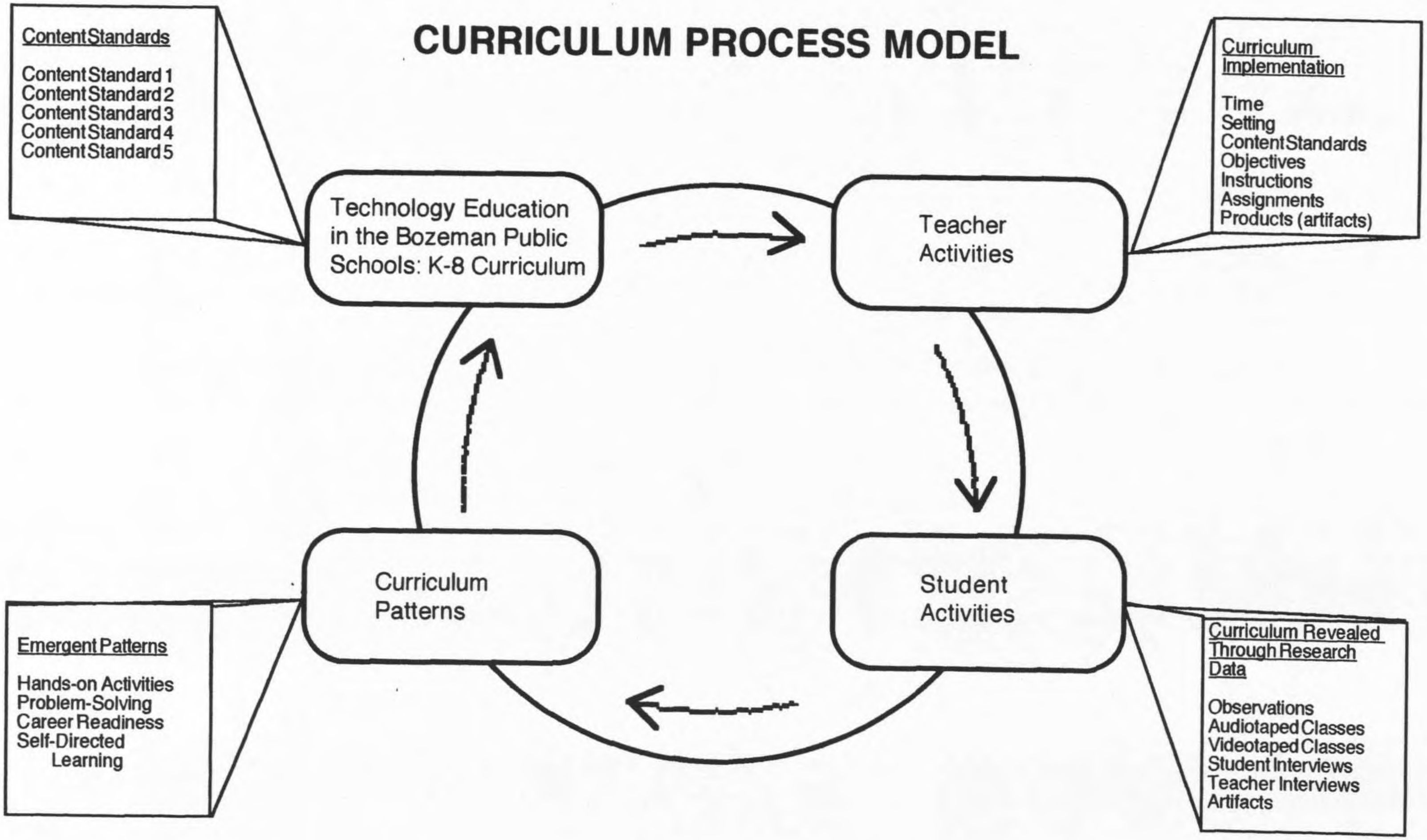
The first week of each six-week rotation consisted mostly of lecture, during which the teacher explained foundational material and demonstrated equipment and tools. During the second through fourth weeks student projects consumed increasingly greater portions of the class period. Students worked on activities such as: "Styrofoam Puzzle", "Business Card", "Rube Goldberg Device", "How Stuff Works", and "Crash Dummy" (See Appendix C). In the fifth week, after all assignments had been explained and equipment demonstrated, students worked the entire period on these projects, with only occasional comments from the teachers. The sixth week was devoted entirely to project completion, testing, and presentation. For example, "Rube Goldberg Devices" were tested to determine the amount of time a ping pong ball took to descend the designed ramps; video clips of "How Stuff Works" were shown to the class; crash cars from "Crash Dummy" were run down a ramp to determine the safety of a raw egg inside.

## Curriculum Process Model

Data presented will support the purpose of the following curriculum process model. This is an open loop model that provides for continuous input and analysis of factors relevant to the Technology Education curriculum. It begins with the five stated Content Standards from Technology Education in the Bozeman Public Schools: K-8

*Curriculum*, which are implemented by technology teachers and become integrated as curriculum factors. The students are subjected to these factors and, as a result of their activities (revealed through interviews, observations, and artifacts), curriculum patterns emerge. These patterns are then compared to the stated Content Standards to determine alignment.

Figure 1.


CURRICULUM PROCESS MODEL
Content Standards
Content Standard 1
Content Standard 2
Content Standard 3
Content Standard 4
Content Standard 5
Technology Education in the Bozeman Public Schools: K-8 Curriculum
Teacher Activities
Curriculum Implementation
Time
Setting
Content Standards
Objectives
Instructions
Assignments
Products (artifacts)
Student Activities
Curriculum Revealed Through Research Data
Observations
Audiotaped Classes
Videotaped Classes
Student Interviews
Teacher Interviews
Artifacts
Curriculum Patterns
Emergent Patterns
Hands-on Activities
Problem-Solving
Career Readiness
Self-Directed Learning

## Curriculum Pattern Identification

Curriculum patterns emerged from constantly comparing class observations, audio taped class lectures, videotaped classes, classroom artifacts, photographs, formal student interviews, and formal teacher interviews in order to identify consistent, unifying themes. The themes that surfaced included hands-on activities, problem-solving, career readiness, and self-directed learning. These curriculum patterns are discussed in detail below. Findings validation is provided through selected quotes, which were transcribed verbatim from taped interviews and lectures.

### Hands-on Activities

Data collected provided a large amount of evidence that students were actively involved in learning through practical activities. These hands-on activities were the primary mode of instruction. The classroom layout and equipment were specialized in order to support specific student engagement in project-oriented work. Multiple computers and work stations equipped with hand and power tools facilitated the process of student activity. Eighty photographs were taken showing facilities or apparatus which were used for these hands-on activities. Table 4 lists facilities and equipment available in the combined classrooms.

Table 4. Classroom Facilities and Equipment Supporting Hands-on Activities.

| FACILITIES | EQUIPMENT |
|---|---|
| Classrooms (with tables & stools) | Computers (Macintosh) |
| Production Labs (shops) | Laser scanners |
| Wood Storage | Digital camera |
| Recyclable Materials Storage | LCD Projectors |
| Nails/Screws Storage | Printers |
| Supplies Storage | Fax machines |
| Student Project Storage | Robots |
| Display Cabinets | Power Tools |
| Laser Studio | Drawing tools |
| Video/Audio Studios | Hand Tools |
| Greenhouse (outdoor) | Televisions |
| Teachers' Offices | VCRs |
| | Video Cameras |
| | Light Tables |
| | Book Binders |
| | Thermal Bag Sealers |
| | Model Greenhouse |
| | Hot Glue Guns |
| | Hot Wire Cutters |
| | Wind tunnel |

The observation instrument used for data collection (See Appendix A) permitted documentation of several different types of instruction, including hands-on activity. Of 21 hours of observed class time, 12.4 hours, or 59% of the time, was spent with students doing hands-on activities.

One of the three audio taped class lectures demonstrated the teacher assigning activities. Teacher quote:

> Your job is to create an advertising package or advertising campaign for their product. The stuff we're going to do is this. We're going to build them a business card. . . . Another thing you're going to do is a full-page magazine ad. (Teacher 1)

> This is a tough one. You need to design and construct a package for a food product. The last section on this is to create a radio ad. . . So, we're going to do business cards, magazine ads, a package that is printed flat and folded up and then a radio commercial. (Teacher 1)

Of the 40 classroom artifacts; 19 of the 20 assignment sheets, all of the 10 classroom instructions, and all of the 10 pieces of student work related to active pupil engagement. For example, the "How Stuff Works" assignment (Appendix C, p. 109) required students to research a technological device, create a sequenced story board, and produce a video on how that item functions. Similarly, the 6th grade classroom instructions (Appendix C, p. 114), listed projects on which students worked. These included technical drawings, puzzle building, and creating a car which would protect a raw egg during a crash. Student work

(Appendix C, p. 119) shows a computer-aided design of a patent for an original device used to control a ping-pong ball in its track through a timed course built by students.

Student statements about doing activities or projects were described or mentioned 100% of the time in formal interviews. When asked: "What do you think technology education is all about?", students talked about the kinds of things they did in class. Typical examples are:

> I would think it's more about building and with wood and nails and screws and using tools, learning how to use new tools. (Girl 1)

> Probably the building and learning how to use tools and mostly learning how to use the computer, since that's going to be a big part of our future. (Boy 1)

When asked: "Is this class like or unlike your other classes?", students answered:

> It's different because like you have to build stuff yourself. You can't really . . . you have to work with lots of different computer programs and you have like do lots of hands-on stuff. And so we don't really do that in a whole bunch of my other classes. (Girl 1)

> This is the only class we really get to work hands on with technology. In science class, math and everything, like that you don't really get to work hands on with the technology you get to work with in here. (Boy 1)

The activity orientation of the classroom was shown in the comment one boy made about what he did in technology education:

> You can go to a robot hand where you can program a robot and then make it do things. You can go to the computer, play a factory game and you can make titles and covers in the computer for a booklet that we have to turn in at the end of the year. You can make screwdrivers. There are lots of things you can do here. We're working on egg crash cars right now.

Each of the teachers mentioned hands-on activity as a major component of their curriculum. Teacher comments included:

> He has them make a front cover and back cover for their portfolio using a desktop publishing program. He gives them a problem with an egg crash car. . . He makes a puzzle out of styrofoam, teaches them how to use some tools with it like a styrofoam cutter. Teaches them how to use a plastic injector. (Paraprofessional Teacher)

> Seventh graders also then do a video production on how something works. So we ask them some of those high tech tools that we have in our society like refrigerators, jet engines, how their bike power train works, how does it shift gears, how does it work? So we ask them to do a video production, so they get their hands on video cameras, VCRs, tape recorders, all that kind of stuff. (Teacher 1)

> They do various activities with a bridge design from a CAD generated computer drawing. They do another activity that we call a Goldberg device, ping pong movement machine, if you want to call it that. They employ a CAD drawing, a plan, at least in part. (Teacher 2)

Table 5 uses percentages to indicate the amount of data supporting hands-on activities. For example, 59% of the observation time showed students actively involved in building or making things. Also, 98% of written classroom artifacts represented hands-on activities.

Table 5. Hands-on Activities.

| TYPES OF DATA | PERCENTAGES OF DATA | N= |
|---|---|---|
| Observations | 59% | 31 |
| Audiotaped Lectures | 33% | 3 |
| Artifacts | 98% | 40 |
| Photographs | 87% | 92 |
| Student Interviews | 100% | 37 |
| Teacher Interviews | 100% | 3 |

Problem Solving

Data collected provided a great deal of evidence (see Table 6) that students were engaged in problem solving behavior. In all of the observed classes, students used the following strategies to solve problems:

- Worked directly from design drawing assignments.
- Built apparatus from specifications.
- Used materials and tools selected for specific applications.
- Produced solutions to project assignments.
- Accessed classroom resources for information with which to develop answers to stated problems.

Every audio taped class lecture dealt primarily with problems the students were expected to solve. On one of the tapes the teacher said:

> We say we're going to follow the life cycle of a technology from need, right here, out to useable product. And we're going to go through this whole

> list of stuff. Building this puzzle, okay? Puzzle requirements, look at that. Puzzle requirements are the specifications. Maximum size, what is it? Seven inches by 10 inches. Minimum size? What? Four inches by five inches. How many pieces? At least six, no more than 12, that's an important thing to keep in mind. Pieces must interlock not simply interconnect. What does that mean? (Teacher 1)

All of the videotaped classes dealt with solving some type of problem. Sixth graders had to determine the correct manner in which to attach a piece of paper to a drawing board; 7th graders had to communicate a description of an object by telephone; 8th graders had to determine what went wrong when the video studio did not work as anticipated. On the videotape, the teacher said:

> The purpose of the assignment is to learn as much information as you can right away and then use the equipment, experiment with the equipment, read the manuals if you have such an inclination, struggle with it, and get it to work, because that's the way you're going to deal with new technology the rest of your life. If you don't know how it works you're gonna have to figure it out. (Teacher 2)

All classroom artifacts, assignment sheets, white board instructions and student work assignments were related to solving problems. In interviews, all students talked about solving problems. They spoke about:

> We do a lot of different things, like we have to get, we have our problem and we have to fix it. (Girl 1)

> Sometimes the project is to learn how to work different things and figure out how to do things. (Boy 1)

> Um, partly it's kind of related [to other classes] like he uses some math and sciences in figuring out things. But a lot of times the goals are different and stuff and he doesn't just tell us the information and have us, you know, retell him it again, you know. And he doesn't give us the answer right away; we have to figure it out ourselves instead of with the other classes where you just pretty much get it and then restate it on a test or something. (Girl 2)

One 7th grade student described a problem-solving idea for his Rube Goldberg device design:

> You have a wheel, an axle and a wedge, and a pulley and I think that's it. Well, we had to draw those on the picture and I made something to light the candle, and what I put was a ball going up and rolling and getting different things, about falling on the wheel so the wheel would move. I drew a match on the wheel so when the wheel moved, the match would go with the wheel and strike on the ground so it would light up. The wheel would go all the way around and the match that is lit would go to the candle and light it. (Boy 1)

In teacher interviews, every teacher mentioned problem solving as the philosophical foundation of the curriculum. Teachers said:

> I guess what they're really into now is problem solving. That's my perspective on how he teaches, is problem solving. He provides them with a problem and how he teaches, he has a graph on needs, ideas, design, making, selling, the use and the disposal, and this whole six weeks has been part of that. He has different assignments that fit right into that diagram. He has a computer drawing which has a need. Everything is based on problem solving mainly. (Paraprofessional Teacher)

> But technology basically is what human beings design, build and make to um solve the problems that they've encountered in their lives. So technology education would be education about how

> to design, build and make things that solve problems in peoples' lives. (Teacher 1)

> Always the problem solving skills. That's the whole basis of the class to use technology to solve problems is one of my major goals and try to teach a problem solving method procedure apply that to any type of problem whether the problem deals with an assignment or other technologies they run into or any situation in life really. (Teacher 2)

Table 6 uses percentages to indicate the amount of data relating to problem-solving. Problem-solving was evident in each of the 31 observed classes, the 3 videotaped classes, and all artifacts and interviews.

Table 6. Problem-Solving.

| TYPES OF DATA | PERCENTAGES OF DATA | N= |
|---|---|---|
| Observations | 100% | 31 |
| Audiotaped Lectures | 100% | 3 |
| Videotaped Classes | 100% | 3 |
| Artifacts | 100% | 40 |
| Student Interviews | 100% | 37 |
| Teacher Interviews | 100% | 3 |

Career Readiness

The data collected produced the following categories of evidence suggesting career readiness as a consistent theme:

- Preparation for employment
- Time management to meet deadlines
- Developing personal responsibility

- Teamwork
- Real-world relevance (classroom setting and activities)

In classroom observations, every class included elements of the above career readiness categories. The observation instrument permitted documentation of real world application relevance. In every observed class, the class content was Almost Always relevant to applications that occur in the employment sector. (See page 2 of the observation instrument, Appendix B.) In addition, classes were structured to simulate an employment environment. In one class, a student was "fired" from his "job" for turning on a power tool without permission. This resulted in his loss of that period's work time for projects which had deadlines for completion.

Preparation for Employment. Twenty students (54%) mentioned some aspect of career readiness as meaningful to them. In relation to future employment, they said the following when asked what technology education was trying to teach them.

> We're going to have to know this really to get a job and make a living. (Boy 1)

> Probably teaching you how to work on industrial pieces of equipment and showing you how to cooperate with other people. And the reason you need to learn how to work industrial pieces of

> equipment is you might need them in a job you might get. (Boy 2)

In an interview, a teacher told how he perceived the setting of his classroom as employment-related.

> Architecture is high pressure. That's another thing that we do. We pressure these kids. There's a lot of work in short periods of time to have to make quick decisions . . . They have to, you know . . . Realistic work environments. Pampering them isn't going to get us anywhere. I think as a society we pamper them too much. (Teacher 2)

<u>Time Management To Meet Deadlines</u>. Students also stated that time management was important. When asked what he had learned in technology education, one boy said:

> Um, that the real world's kind of difficult because you really have to manage your time like I said before and that's what I really learned. And you have to really like to do stuff in order not like throw them around and stuff. So I've learned like responsibility of managing my time. (Boy 1)

One teacher said the following about his conception of time in a class lecture:

> So time does have value. There is a money number hooked to time. This paper is valuable now because what that stamp means is it came in on time. You turned it in on time. . . . That means I can give it full credit when it does get turned in. . . . Time has value. And therefore, in this class, should you hang out and mess around wasting time? No. That won't help you. (Teacher 1)

Deadlines for project completion were an integral component of class work. When asked what technology education was trying to teach, one girl answered:

> I mean partly it kind of teaches us some business skills with, you know, like a lot of computers and everything. It does kind of get us to work with deadlines and how real businesses would work and stuff. (Girl 1)

When asked what she liked least in tech ed, another student said:

> Probably the deadlines. You have to do a lot of work. You can't just use one period a week and talk to your friends, you have to work the whole time because you have to turn things in on time or he won't take it, which is why you need to use all your class time.

Developing Personal Responsibility. As a component of career readiness, several students said that they thought responsibility was a part of technology education. One student told how he learned to be responsible:

> Well, cause you have to keep track of all your stuff in this class. I mean he doesn't collect anything for you. Like any papers, you have to keep it til the end of the six weeks and if you lose it, then that's your problem. (Boy 1)

Teamwork. Students also mentioned teamwork as a class component. When asked what was the most important thing they had learned, they said:

> How to work with people through rough problems and put things together that you didn't think were really possible to put together. (Girl 1)

> Um, well, a lot of like team work and cooperation. Trying to pace myself and make sure I get things done on time and stuff. (Girl 2)

One teacher also talked about teamwork:

> I try to impress upon them that group work is more like real life situations where we have to learn to work with each other and accomplish a common objective. So all my classes there's at least some group work usually in groups of three or four kids. (Teacher 2)

Another teacher commented about why students worked in teams:

> When you have a job someplace, odds are you're going to be working with a bunch of people that you don't know. You might know one or two of them; they might have helped you get the job. But, you're going to end up someplace working, not knowing who these people are. And you're going to have to develop relationships to get the job done. . . . It's really important that you learn how to build those kinds of relationships. It's pretty tough. There's no question it is tough to do. (Teacher 1)

Real-world Relevance (Classroom Setting and Activities). Effective technology education produces student awareness of the requirements of life in the world of work (Johnston, 1993). In the observed middle schools, real-world activities were a focus of technology education classes. When asked what they thought technology education was all about, students said:

> Teaches you how to work in real life. You apply your skills in real life, I guess. (Girl 1)

> Helping when you grow up and have to do machinery work it will help you because you already know how to work it and stuff. You'll know how to make screwdrivers. You'll know how to work, where to go on your computer, helps you in computer education. Like this one, we have big robot claws

> like that in the big world and you have to know how to use them, so this is just a mini-version of what you're going to have to use when you grow up. So, I think that's a reason they're teaching us now so when we grow up and have to use this stuff. (Boy 1)

When asked if she thought technology education taught her any skills that she really needed, one girl said:

> Like, um, if you wanted to be an architect, it tells you how to like, um, like build stuff and like, um, do correct measurements and do blueprints and teaches you if you wanted to be like a movie maker or something, it teaches you how to do that. (Girl 2)

Self-Directed Learning

Data suggested that learning was directed largely by the student after initial information was provided by the teacher. The observation instrument provided a record of Student Autonomy as practiced in Lab/Other Activity (see Appendix B, #27). Sixty-eight percent of observed classes indicated that lab or other activity was completed with substantial student independence. Students were observed operating by themselves, independently and in groups, to achieve stated class goals without teacher direction. Teachers were available only as resource personnel during active student work.

Students indicated that self-directed learning was a facet of the class process in 17 interviews (46%). One boy described such work during the last week of class:

> When we come in, Mr. _____ usually talks to us about what we're going to do today and then he asks who is going to do certain stuff and then he lets us go and work and he'll walk around the class and see who needs help. If we need help, he'll help us, and sometimes we have to do certain work where it needs parental guidance, sort of, so he'll help us with that. . . . But, a lot of what it is, he doesn't really care about how you do it, as long as you get it done. I think that's one of the fun things, because he lets us do what we need to do and he doesn't always tell us we have to do this to do that, he just lets us work on our own. We make really cool stuff, so it's really neat. (Boy 1)

When asked if technology education was like their other classes, students commented:

> I don't see how it's like other classes because I mean you basically get to do whatever you want. You know, you're in charge of yourself. And in other classes I mean you have like teachers like, you know, like just watching like constantly. I think it's pretty cool that he just, you know, he trusts us and stuff just to let us go. (Girl 1)

> It's not like them at all. You are able to make your own decisions on how something is made and how to design it and you don't really sit down and work with the teacher all that much. Basically you're going from him just telling you the basics and then you're going on from there and going through your own problems and deciding what to do. (Girl 2)

Another girl said that technology education:

> . . . teaches you that not everybody's going to be there holding your hand the whole way through this class. You have to do it on your own. (Girl 3)

Fostering responsibility through the independent use of resources was mentioned as a classroom component by the paraprofessional teacher.

> Mr. _____ is letting them do what they want with the computers, trusting, with the computers, that they're not going to break it. Trusting them with the plastic injector, something hot where they could hurt themselves, you know, potentially hurt themselves if they don't pay attention. And he teaches them a lot of responsibility, because a student will come up and ask him a question and he'll say, "Didn't I already teach you that?" and they'll say, "Yeah, but will you help me?" and he'll say, "No, it's right up there on the board," if he has the lesson up on the board, or tells them the objectives they need to get done. . . . He doesn't give in to helping them, unless they're really struggling, and then he'll help them, but if it's just a simple question where they can go look for the resource, find it and get the information, they know where to look. (Paraprofessional Teacher)

## Content Standards and Curriculum Patterns

In order to determine curriculum pattern alignment, each of the five Content Standards in Technology Education in the Bozeman Public Schools: K-8 Curriculum was reviewed in light of the data collected for this study. All Content Standards are in Appendix G. Data were compared to determine if each standard was being addressed in the curriculum. The evidence found to support each standard is discussed.

### Content Standard 1

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be

> able to: *Apply various modern technologies to access, scan, select, retrieve, sort, prioritize, and present information* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

Evidence supporting alignment with Content Standard 1 included documentation that 26 of the 31 observed classes (84%) related to the task categories in Content Standard 1. Table 7 shows the equipment used, student tasks, and products demonstrating alignment with this content standard.

Table 7. Class Assignments Reflecting Standard #1.

| REQUIRED TASKS | EQUIPMENT | PRODUCT/ ARTIFACT |
|---|---|---|
| Access, select, retrieve, prioritize, sort, and present information | Computers and Peripheral Devices | Booklet Cover |
| Access, select, retrieve, prioritize, sort, and present information | | Business Card |
| Access, select, retrieve, prioritize, sort, and present information | | 3-D Kiosk |
| Access, select, retrieve, and present information | | Technical Drawings |
| Access, select, retrieve, prioritize, sort, and present information | | HyperCard Stack |
| Access, select, retrieve, prioritize, sort, and present information | | Magazine Advertisement |
| Access, select, retrieve, prioritize, sort, and present information | | Factory Game |
| Access, select, retrieve, prioritize, sort, and present information | | Booklet covers |
| Access, select, retrieve, prioritize, sort, and present information | Video Equipment | Videotape |
| Access, select, retrieve, prioritize, sort, and present information | Audio Equipment | Commercial |

Two audiotaped class lectures focused largely on Content Standard 1 related areas. Approximately 45 minutes of lecture and demonstration were dedicated to computer work and modern blueprint processes. In one of the lectures devoted to accessing and retrieving pictures from a CD-ROM, the teacher said:

> Here's how you go find pictures. It's a couple of mouse clicks, it's so easy, you can't believe it. File, insert, not open, insert. Go to the desktop, find the CD right here, double click it. Don't go into the image catalogs, that's not where you're going to find the picture, all that is a list of names. The actual pictures are in the clip art folder. We're going to look for food, right? Type an F. Food and drink right there. Double click it. (Teacher 1)

One of the three videotaped classes (40 minutes) was dedicated to a video equipment demonstration. On this tape the teacher talked about:

> In our system we have an audio editing center, a video editing center, some mixers that mix things signals together, and then some monitors to see what's going on. Every one of these requires electrical power to run, so that's probably the first thing to do is to turn on all the power. . . You're required to add some audio to the tape. That could be your own voice, commenting on the egg crashes. You don't have to have music. (Teacher 2)

Thirty-three artifacts related to Content Standard 1 areas. Fifteen of the 20 assignment sheets (75%), 8 of the 10 white board instructions (80%), and 9 of the 10 examples of student work (90%) demonstrated elements of Content Standard 1.

In 37 student interviews, 35 students spoke about doing one or more activities related to this standard. Student comments about these activities included:

> I've worked on the business cards with one of my partners for the family consumer science people and I've made 3-D advertising ads and . . . I'm working on a HyperCard stack. (Boy 1)

> I like best making our videos because then you learn like how to do like, um, sound effects on your videos and record, and I think it's a good skill building activity. (Girl 1)

Each of the interviewed teachers spoke about professional philosophy relating to Content Standard 1. Comments included:

> Everybody in our society today needs to know about computers and how they work. That' a basic skill in today's society. Um, basic skills would be how do you save a file, how do you retrieve a file, how do you draw a picture, how do you get what you want on the screen, how do you get what you want on the page. So there's basic skills of information processing some of them are computer related. (Teacher 1)

> Different category systems of technology and how they work and how if we understand the basic principles of any given piece of technology we can probably relate that to a whole family of devices that operate under the same principles. We use the video camera and video studio to make a video tape of how something works and pretty exciting assignment to see the examples. (Teacher 2)

Table 8 uses percentages to indicate the amount of data relative to hands-on activities for Content Standard 1.

Table 8. Content Standard 1 Data Percentages.

| TYPES OF DATA | PERCENTAGES OF DATA | N= |
|---|---|---|
| Class Observations | 84% | 31 |
| Audio taped Class Lectures | 50% | 2 |
| Videotaped Class Lectures | 33% | 3 |
| Artifacts | 83% | 40 |
| Student Interviews | 95% | 37 |
| Teacher Interviews | 100% | 2 |

Content Standard 2

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Design, develop, and implement solutions that meet opportunities, or satisfy human wants and needs through the use of ideas, tools, materials, processes, and resources* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

The major methodology to address Standard 2 is problem-solving (K. Bruwelheide, personal communication, March 12, 1998). In devising solutions to problems stated by the teachers, students in technology classes worked directly from design drawings to build apparatus using materials, tools, and classroom resources. Teachers served as facilitators of experimentation and critical thinking, guiding students to meet specifications using general problem-solving methodology. Evidence supporting the curriculum pattern of problem solving can be found on pp. 50-53. Alignment with Content Standard 2 was shown by students engaging in problem solving behavior in 100% of the data (See Table 6, p. 53). Table 9 illustrates the problem-solving elements present in the classroom assignments.

Table 9. Class Assignments Reflecting Standard #2.

| REQUIRED TASKS | EQUIPMENT | PRODUCT |
|---|---|---|
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Computers | Booklet cover |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | | Business card |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | | 3-D Kiosk |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | | Techni-cal Drawings |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | | Hypercar d Stack |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | | Factory Game |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Audiotape recorder | Audio Commer-cial |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Hardware, Tools & Materials | Rube Goldberg Device |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Hardware, Tools & Materials | Crash Dummy |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Thermal Sealer, Tools & Materials | Styro-foam Puzzle |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Video equipment | "How Stuff Works" |
| Design, develop & implement solutions that satisfy human wants & needs through the use of ideas, tools, materials, processes, and resources. | Computer, Hardware, Tools & Materials | Bridge Design and Building |

Content Standard 3

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Explain that the development of technology is evolutionary; that it is shaped by societal values; how it influenced history; and how it is a major factor in their future* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

Data collected provided evidence that four students perceived that technology plays a major role in their future. When asked: "What do you think that technology education is all about?", students said:

> Just teaching you about how life is going to be. (Girl 1)

> Um, pretty much I guess you could say how to survive in a world where all of this technology is pretty much going to be in our future. (Boy 1)

> I think just teaching us about the world in advance like all of the stuff that could be or that is that we need to know about. Because he like really talks to us about like just like how the world is going to be when you're older so what really I really see about it. He really talks to us about, um, how everything's going to be and you need to be prepared for the future. (Boy 2)

> That it's really important and when you get out of school it's going to be really important, and it's important now. (Girl 2)

In an interview, one teacher said that he felt the one of the main purposes behind technology education was to prepare students to encounter technology in the future. He said:

> To learn strategies for learning to understand and deal with new technologies that inevitably are going to be, they're going to be facing daily for the rest of their lives. I guess that's one of the main purposes I guess [laugh]. (Teacher 1)

Evidence supporting Content Standard 3 did not emerge from classroom observations, audiotaped lectures, videotaped classes, artifacts, or photographs/drawings. Student and teacher interview evidence emerged as stated above.

Content Standard 4

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Recognize that the careers of the future will require higher levels of technical training, academic literacy, critical thinking, and problem solving skills* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

Data producing evidence of alignment with Content Standard 4 was discussed in the section on Career Readiness (pp. 53-58). Preparation for employment, time management, meeting deadlines, developing personal responsibility, teamwork, and real-world relevance were addressed repeatedly in the technology classroom. Comments supporting Content Standard 4 may be found on pp. 53-58. A great deal of evidence supported the recognition that careers of the future require technical skills and problem-solving abilities (see section on Content Standard 2, pp. 65-67). One teacher also stated that critical thinking was a cognitive skill he tried to impart to students.

> You've got to be able to make decisions. You've got to be able to base the decision on, um, good reasoning. Where did you get the information? What's the source? Is the source valid? Um, that's important. A lot of people make decisions on information and the source is bogus. So being able to make good critical judgements I think is very important. That's a life skill. That's a job skill, a business skill. It doesn't matter what you do in life, you need that . . . being able to critically judge what other people say to you. The same skills to solve the problems in class are the same skills they can use in their life. (Teacher 1)

Content Standard 5

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Predict and evaluate the impact to themselves, society, their culture, and the environment of existing or proposed technologies by assessing the positive or negative, planned or unplanned, and immediate or delayed consequences* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

One datum was collected supporting Content Standard 5. In an interview, one teacher said the following about the standard in relation to the aim of technology education:

> The . . . goal is to understand that when you do use technology that there are consequences to those actions. That technology doesn't

> automatically by its nature provide only positive solutions. . . . So basically one of the questions or one of the things we talk about quite a bit is we know we can do it. Should we do it? Does just knowing how to do the technology and being able to use it authorize us automatically as a culture to use it? Things like gene splicing. We talk about kids' future a lot, I mean in discussions we talk about what if you could grow 4 or 5 human hearts in a pig for transplant. Is that OK? Tough question. You'd be surprised what kids come up with when they start talking about those types of thing. Is it OK to kill 50,000 people on our highways every year because we like cars? Good question. Injure 400,000, is that OK? So we're asking attitudes. Yeah we live with technology, but at the same time be careful because making blind decisions doesn't necessarily help you in the future. Been a lot of those in the past. (Teacher 1)

This comment illustrates the evidence supporting Content Standard 5. Other data did not surface from class observations, Audio taped classes, videotaped classes, artifacts, photographs/drawings, or student interviews to support this standard.

## Other Findings

The following findings were not curriculum patterns but represent categories which emerged in the course of analysis and are worthy because of their consistency and frequency of appearance.

Curriculum Integration

Classroom artifacts revealed that other academic areas were being addressed in the activities and assignments completed by students in the technology education classes (See "Crash Dummy Experience", Appendix C, p.110). Assignment sheets evidenced cross-curricular integration in the required use of multi-disciplinary skills. Students engaged in writing, mathematical calculations, principles of physics, and group dynamics in the process of designing, building, and testing their projects. A detailed review of lesson plans and other artifacts may be used to provide further evidence of this occurrence.

Limited Class Work Time

In interviews, both students and teachers spoke about not having enough work time in technology education classes to accomplish the assigned projects. These comments represented different viewpoints on the subject.

Student Comments. Fifteen students (41%) said that they didn't have enough time to work on their projects. Eight students stated that six weeks was not enough time to complete the work; seven students made general statements that they need more time. When asked what they might change about technology education class, students said:

> More time to work, like a couple of more weeks, to work on our projects. (Girl 1)

> I don't know. I may give a little bit more working time, not too much, but just a little bit. (Boy 1)

When asked what they liked least about technology education, students commented:

> We only have it for six weeks. That's kind of a drag because we don't get to do everything that we would like to do because we only have six weeks. (Boy 2)

> The time. We don't have much time at all. . . . [If I could change it, I'd] make this class 12 weeks. (Girl 2)

Teacher Comments. Both classroom teachers made statements about restrictions on available time. In response to the question: "What would you say are the limitations of your program?", the teachers said:

> Too many possibilities, not enough time. . . . Deciding what should you teach in the time you're given. What is going to be of value to them, what isn't. . . . The other thing is our class is too short. Six weeks of 6th grade, yeah, that's survivable. Nine weeks of 7th grade would be a much better solution than the 6th. They just get into finding a good solution by six weeks because those are more complicated problems. (Teacher 1)

> Time. Classes are too short. Sixth grade's okay at six weeks. Seventh grade is too short, it should be nine. Eighth grade should be 12. That's my limitation. I don't have enough time. (Teacher 2)

Videotaping

Data exhibited evidence that videotaping was used a great deal in one middle school classroom. Students in both schools used videotaping for assignments in 13 class periods of the 31 classes observed (42%). The teachers used videotaping for the following purposes in conjunction with student assignments.

- As an instructional tool to demonstrate subject matter and processes.
- To record student projects for future instructional use.
- As an assignment theme for student projects.

In one of the schools, video equipment was used for purposes other than the technology curriculum. The researcher observed videotape being used in the following ways:

- To make student-produced videos to be shown school wide (such as basketball game taping and infomercials).
- To monitor other teachers' classes to help enforce discipline.
- To produce a filmed account of professional projects for the technology teacher's year-end evaluation.

- To help other teachers record student projects for presentation to parents and administrators.

## Summary

Data presented address the degree to which classroom observations, audio taped class lectures, videotaped classes, classroom artifacts, photographs of facilities and apparatus, teacher and paraprofessional teacher interviews, and student interviews revealed curriculum patterns in Chief Joseph and Sacajawea Middle Schools. Through the interaction of students with classroom activities designed to address Technology Education in the Bozeman Public Schools: K-8 Curriculum, this scheme of curriculum pattern development reveals the alignment with the stated Content Standards.

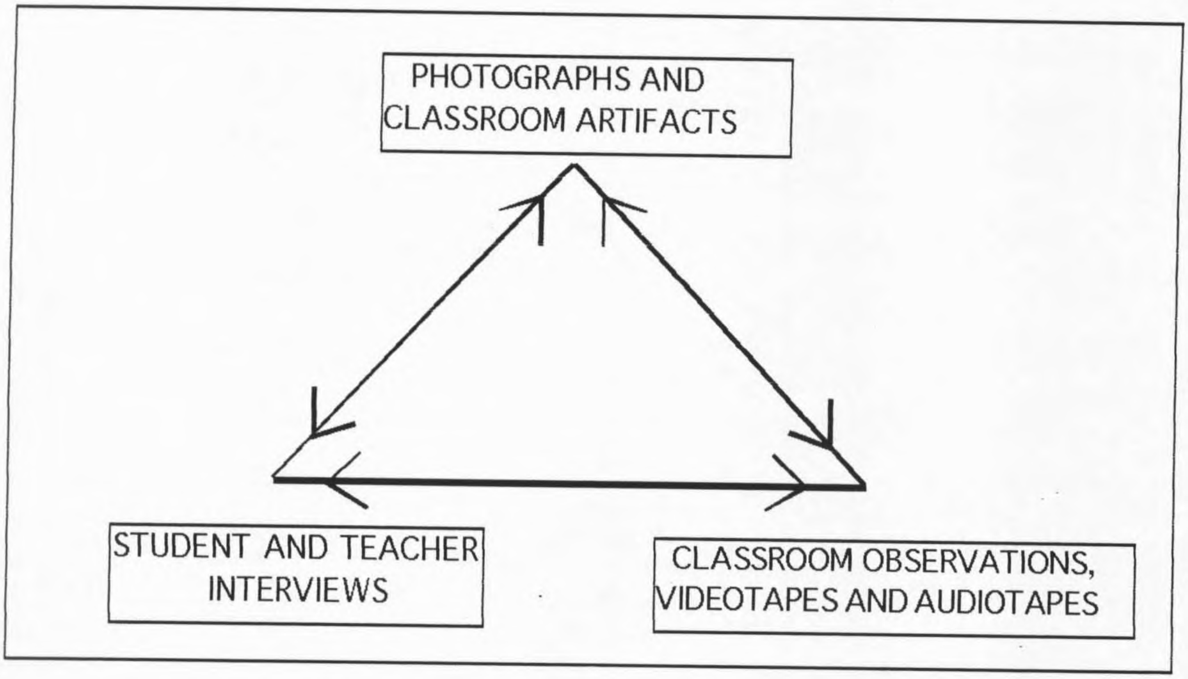
# CHAPTER 5

# SUMMARY, CONCLUSIONS, AND IMPLICATIONS

## Introduction

Through qualitative case study methodology, this research identified the curriculum patterns present in middle school technology education in Bozeman, Montana; and compared the patterns with those stated in Technology Education in the Bozeman Public Schools: K-8 Curriculum. It also reported other findings that surfaced during the course of the study. The process of triangulation was used in analysis to solidify the relationship among multiple data sources. Figure 2 is a graphic representation of the triangulation of photographs and classroom artifacts; classroom observations, videotapes, and audiotapes; and student and teacher interviews.

Figure 2. The Process of Triangulation, Analysis Model




The summary, conclusions, and implications are presented as they relate to the stated research questions.

## 1. Curriculum Pattern Development

Students used hands-on activities in problem solving, career readiness, and self-directed learning. They designed and built projects such as Rube Goldberg devices and packaged styrofoam puzzles. Working in a simulated job-like environment, they managed their time on multiple projects to meet six-week deadlines. Students researched and created solutions to problems given by the teachers independently of the teacher after initial guidelines were presented. The

Curriculum Process Model (p. 44) illustrates the continuous influence of Content Standard integration in the classroom on student activities and curriculum pattern development.

Hands-on Activities

The primary mode of instruction in technology education classrooms was hands-on activities used by students in class project assignments. Students built projects and worked with technology to accomplish tasks. Teachers' comments as well as student statements about the technology education classes reflected a concrete activity focus. Classroom equipment as well as artifact documentation supported this pattern, as well.

Problem Solving

Problem solving was a consistent curriculum theme, as students designed and built physical solutions to questions posed by teachers. Tools and materials, classroom resources, and thinking skills were combined to produce unique answers to complex questions. Observations, audiotape and videotape, artifacts, photographs, students, and teachers each presented evidence to support the fact that students were active problem solvers in these classes.

Career Readiness

Students in the technology classrooms were actively learning the skills needed for future employment. The classroom themes relating to career preparation were:

- Preparation for employment
- Time management to meet deadlines.
- Developing personal responsibility.
- Teamwork.
- Real-world relevance (classroom setting and activities) as defined in the technology education literature.

Self-Directed Learning

Learning in the technology education classrooms was directly primarily by the student after guiding information had been imparted by the teacher. The students' personal responsibility was evident in the activities as well as in the problem-solving strategies used to construct the projects. Independent learning included being able to find and use appropriate classroom resources, such as tools, materials, and software.

## 2. Curriculum Pattern Alignment

Curriculum patterns, when compared with the content standards in Technology Education in the Bozeman Public

Schools: K-8 Curriculum, produced some shared alignment with each of the five content standards. The extent to which the curriculum patterns supported the content standards varied. Considerable evidence supported Standards 1, 2, and 4. Less evidence emerged to support Standards 3 and 5.

Content Standard 1

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Apply various modern technologies to access, scan, select, retrieve, sort, prioritize, and present information* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

Alignment with this standard was sustained by a large amount of evidence as the majority of observations, artifacts, student interviews, and teacher interviews supported the ability of technology education students to create booklet covers, business cards, magazine advertisements, HyperCard stacks, kiosks, factory game printouts, and technical drawings using computers and a digital camera. Students also used video and audio equipment in the creation of video reports and radio commercials. Approximately one third of the photographs of classroom facilities and equipment also supported this standard, showing the computers and related equipment which were used to achieve the stated goal.

Content Standard 2

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Design, develop, and implement solutions that meet opportunities, or satisfy human wants and needs through the use of ideas, tools, materials, processes, and resources* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

All data sources consistently provided evidence of technology education students' ability to provide solutions to stated problems. Using many types of tools and materials, students designed and built answers to complex questions posed by teachers to make Rube Goldberg devices, styrofoam puzzles, bridges, kiosks, and crash dummies. They also completed numerous tasks using the computer. The classrooms resembled workshops where ideas were allowed to flourish in experimentation and prototypical designs in the effort to satisfy the demands of specific dilemmas.

Content Standard 3

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Explain that the development of technology is evolutionary;*

> *that it is shaped by societal values; how it influenced history; and how it is a major factor in their future* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

The evidence supporting this standard consisted of 4 out of 37 student interview references to students' realizations that technology is important now and will become more important as time goes on. One teacher also made an allusion to the importance of teaching students to deal with the technological future.

Content Standard 4

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Recognize that the careers of the future will require higher levels of technical training, academic literacy, critical thinking, and problem solving skills* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

Preparation for employment, time management in meeting deadlines, development of personal responsibility, teamwork, and real-world relevance of technology classroom setting and activities emerged as major evidence to support the pattern of readying students for careers. Students came to "work" when they entered class, were "fired" for misbehaving, and were pressured to meet assignment deadlines. They were given a large amount of personal accountability for project completion, including managing their time to get needed work done. They often worked on projects in teams, and were schooled in the fact that real life requires real skills using and understanding technology.

Content Standard 5

This standard states:

> Upon their graduation (after having attended technology classes K-12 in which this curriculum has been an integral part), graduates should be able to: *Predict and evaluate the impact to themselves, society, their culture, and the environment of existing or proposed technologies by assessing the positive or negative, planned or unplanned, and immediate or delayed consequences* [italics added]. (Bozeman School District #7 Technology Committee, 1994, p. 4)

In this study suggests that one datum emerged as evidence to support students' ability to recognize possible future consequences of technology. This datum came from a teacher interview reference to the consequences of technology and the ethics surrounding that issue. The teacher noted that technology has both positive and negative consequences and that it is the students' role to evaluate possible consequences before acting (see p.70).

## Other Findings

Other factors were observed to influence the effect on curriculum patterns. These include the following.

Curriculum Integration

Assignment sheets demonstrated that academic skills were being addressed alongside technological development in the technology education classroom. Communication arts, science, math, and complex social interactions were necessary to accomplish the tasks required by the teachers. For example, the styrofoam puzzle assignment (Appendix C, p. 105) requires students to design and make a packaged styrofoam puzzle for potential marketing. This project involves art, math (measurement and calculation), spatial reasoning, computer skills (word processing and graphic arts), and communication arts (spelling, grammar, punctuation).

Limited Student Work Time

Both students and teachers stated that the technology education classes were too short to achieve the desired classroom goals. Students said they felt they did not have adequate time to work on assignments; teachers stated that their efforts to present technology education curriculum were hindered by the present 6-week time rotation period. The researcher observed that this evidence may reflect a difference in point of view of teachers and students.

Videotaping

In one middle school videotaping was used frequently and consistently for the following areas outside of student assignments. Videotape was used to:

- Make student-produced videos shown throughout the school for education and entertainment.
- Help other teachers monitor their classrooms to assist in student discipline.
- Produce a filmed synopsis of professional projects for the technology teacher's year-end evaluation.
- Permit other teachers to record student projects for presentation to parents and administration.

## Conclusions

The curriculum showed alignment with the stated content standards in Technology Education in the Bozeman Public Schools: K-8 Curriculum. Content Standards 1, 2, and 4 were strongly supported by evidence collected in the study. They maybe considered to have been accomplished in the curriculum. Less evidence was collected which supports standards 3 and 5. This may be due to the limitation of time spent in the classroom, the particular periods of time during which the study was conducted, or difficulty interpreting the standards in relation to gathered data.

Due to the smaller amount of data collected, standards 3 and 5 maybe considered to have been partially accomplished. Evidence strongly supporting 3 out of 5 standards in the first year separation of a dual school program is appropriate. Table 10 illustrates this conclusion.

Table 10. Summary of Content Standard Alignment Based on Study Findings.

| Content Standards | Conclusions From Study |
|---|---|
| 1 | Accomplished |
| 2 | Accomplished |
| 3 | Partially Accomplished |
| 4 | Accomplished |
| 5 | Partially Accomplished |

Evidence strongly supporting 3 out of 5 standards in the first year separation of a dual school program is appropriate.

Curriculum implementation in the two Bozeman, Montana, middle school technology education classes as observed from February 21, 1997 - May 1, 1997, addresses the goals from <u>Technology Education in the Bozeman Public Schools: K-8 Curriculum</u> in a consistent link to the universal factors of technological literacy as presented in the Review of Literature (Chapter 2). The curriculum is also consistent with the goals of the International Technology Education Association and by the Technology Education Association of Montana (TEAM), of which both classroom teachers are members.

In these classes, middle school children apply technological processes and use skills and tools in an activity-oriented manner to solve problems and make useful products. They are trained in this school setting for a realistic work environment by performing hands-on activities in an employment-related setting. They work independently making decisions and accessing classroom resources to accomplish class projects. They are developing an understanding of technology and its uses in order to become technologically literate citizens.

## Implications

On the basis of the collected data and conclusions of this study, the researcher offers the following implications for the future:

1. Modify the curriculum plan to support Content Standards 3 and 5 at the middle school level.
2. Identify possible causes and solutions for student and teacher perceptions of having limited time to work and/or teach appropriate content.

3. Investigate how technology education faculty may better serve students at large by integrating technology use across the curriculum.

4. Conduct a follow-up study in the second and third years of separate school programs to better assess curriculum patterns and content standard alignment.

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# APPENDICES

# APPENDIX A

# DATA COLLECTION SUMMARY

Data Collection Summary: Sacajawea Middle School, John Hickey, Teacher.

| DAY | DATE | SUBJECT | TYPE OF DATA | QUANTITY | TIME IN MINUTES |
|---|---|---|---|---|---|
| 1 | Feb. 21, 1997 | John Hickey | Interview | 1 | 60 |
| 2 | Feb. 24, 1997 | 6th Grade Class | Observation | 2 | 96 |
| | Feb. 24, 1997 | 6th Grade Students | Interview | 4 | 30 |
| | Feb. 24, 1997 | 7th Grade Students | Interview | 4 | 30 |
| | Feb. 24, 1997 | 8th Grade Students | Interview | 4 | 30 |
| 3 | Feb. 26, 1997 | 7th Grade Class | Observation | 2 | 96 |
| | Feb. 26, 1997 | 8th Grade Class | Observation | 2 | 96 |
| 4 | Mar. 3, 1997 | 6th Grade Class | Observation | 2 | 96 |
| | Mar. 3, 1997 | 7th Grade Class | Observation | 2 | 96 |
| | Mar. 3, 1997 | 8th Grade Class | Observation | 2 | 96 |
| | Mar. 3, 1997 | 6th Grade Students | Interview | 4 | 30 |
| | Mar. 3, 1997 | 7th Grade Students | Interview | 4 | 30 |
| | Mar. 3, 1997 | 8th Grade Students | Interview | 5 | 30 |
| | Mar. 3, 1997 | Paraprofessional | Interview | 1 | 30 |
| 5 | Mar. 11, 1997 | 6th Grade Class | Observation | 2 | 80 |
| | Mar. 11, 1997 | 6th Grade Class | Audiotape | 1 | 48 |
| | Mar. 11, 1997 | 7th Grade Class | Observation | 2 | 80 |
| | Mar. 11, 1997 | 7th Grade Class | Audiotape | 1 | 48 |
| | Mar. 11, 1997 | 8th Grade Class | Observation | 2 | 80 |
| | Mar. 11, 1997 | 8th Grade - Class | Audiotape | 1 | 48 |

Data collection summary for Sacajawea Middle School:

- 18 class observations
- 3 class audiotapes
- 25 student interviews (12 boys and 13 girls)
- 1 teacher interview
- 1 paraprofessional teacher interview

Data Collection Summary: Chief Joseph Middle School, Glen Rintamaki, Teacher.

| DAY | DATE | SUBJECT | TYPE OF DATA | QUANTITY | TIME IN MINUTES |
|---|---|---|---|---|---|
| 6 | Apr. 15, 1997 | 6th Grade Class | Observation | 1 | 48 |
| | Apr. 15, 1997 | 7th Grade Class | Observation | 1 | 48 |
| | Apr. 15, 1997 | 8th Grade Class | Observation | 1 | 48 |
| | Apr. 15, 1997 | 6th Grade Students | Interview | 2 | 15 |
| | Apr. 15, 1997 | 7th Grade Students | Interview | 2 | 15 |
| | Apr. 15, 1997 | 8th Grade Students | Interview | 2 | 15 |
| | Apr. 15, 1997 | Glen Rintamaki | Interview | 1 | 60 |
| 7 | Apr. 21, 1997 | 6th Grade Class | Observation | 1 | 48 |
| | Apr. 21, 1997 | 7th Grade Class | Observation | 1 | 48 |
| | Apr. 21, 1997 | 8th Grade Class | Observation | 1 | 48 |
| | Apr. 21, 1997 | 6th Grade Students | Interview | 2 | 15 |
| | Apr. 21, 1997 | 7th Grade Students | Interview | 2 | 15 |
| | Apr. 21, 1997 | 8th Grade Students | Interview | 2 | 15 |
| 8 | May 1, 1997 | 6th Grade Class | Observation | 1 | 30 |
| | May 1, 1997 | 6th Grade Class | Videotape | 1 | 30 |
| | May 1, 1997 | 7th Grade Class | Observation | 2 | 80 |
| | May 1, 1997 | 7th Grade Class | Videotape | 1 | 40 |
| | May 1, 1997 | 8th Grade Class | Observation | 1 | 40 |
| | May 1, 1997 | 8th Grade Class | Videotape | 1 | 40 |

Data collection summary for Chief Joseph Middle School:

- 10 class observations
- 3 class videotapes
- 12 student interviews (6 boys and 6 girls)
- 1 teacher interview

# APPENDIX B

# CLASSROOM OBSERVATION INSTRUMENT

*____week of 6 week rotation____ 1. Date

## CLASSROOM OBSERVATION

2. School______________________________ 3. Time

4. Teacher__________________ 5. # Students_____ 6. Period

7. Grade Level____ 8. Total Time Observed

### Class Checklist

(The approximate time for the instruction strategy used in this class)

*Type of Instruction*:

| | | | |
|---|---|---|---|
| **L** | lecture | **WW** | written work |
| **LWD** | lecture with discussion | **D** | demonstration |
| **CD** | class discussion | **CL** | cooperative learning |
| **HOA** | hands-on activity/materials | **SGD** | small group discussion |
| **AD** | administrative tasks | **TIS** | teacher/student interaction |
| **Oth** | other____________________ | **LWQ** | lecture with question/answer |

Minutes Spent in Instruction

| 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-5 | 5-10 | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | 40-45 | 45-50 | 50-55 | 55-60 |

21. **Description of setting** (Seating/size/facilities/lighting/ ethnic):

22. **Description of apparent goals/objectives:**

23. **Evidence of learning** (Were the goals/objectives met):

24. **Content** (Description):

25. **Relevancy:** Almost Always Sometimes Almost Never Never
(Real world applications)

26. Description:

27. **Lab/Other Activity:**
Considerable Student Autonomy | Some Student Autonomy | Driven by Teacher/ Text Instruction

28. Description:

29. **Use of Technology** (Describe):

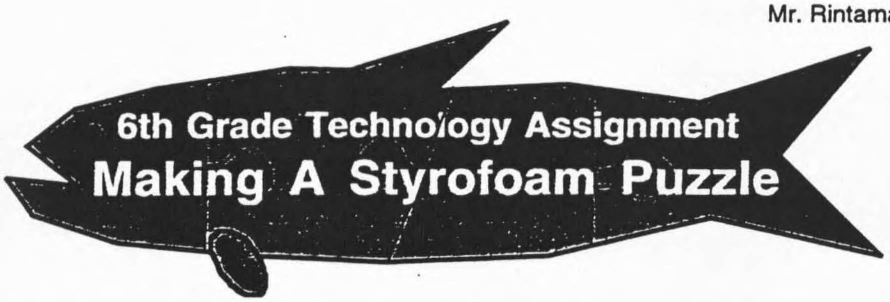
30. **Notes and Comments:**

# APPENDIX C

# CLASSROOM ARTIFACTS

SAMPLE
ASSIGNMENT
SHEETS

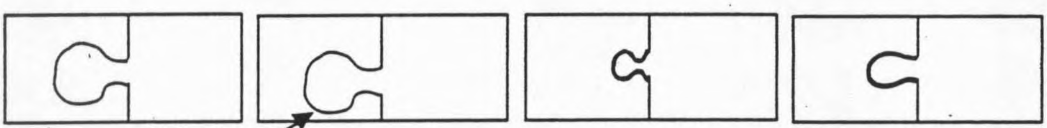
Mr. Rintamaki '96




**THE PROBLEM** - **Design, then create from your design a puzzle made of Styrofoam that satisfies all of the requirements listed below. The finished puzzle must be packaged in a Zip-Lock bag with a label that meets the requirements listed on page 2.**

## THE DESIGN REQUIREMENTS

- **The puzzle must have at least 6 interlocking pieces.**
- **The puzzle may not be any larger than 5" X 7"**
- **The outside edges of the puzzle must form the outline of an object (fish, car, foot ball, etc.) or be the connected initials of your name**
- **The puzzle must contain hand colored details.**



**Good Interlocking Pieces** | **Too Close To The Edge** | **Interlock too Small** | **Poor Interlock**

## STEP #1- MAKE A TECHNICAL DRAWING OF YOUR DESIGN.

**- Make a standard 1/2" border and title block on 8 1/2" x 11" paper using a T-square and triangle.**
**- Draw your design centered on the paper. Show all the pieces and how they interlock. Show 2 dimensions, the overall length and width of the puzzle. Add color to the drawing as it will appear on the finished puzzle.**

**<u>THIS DRAWING SHOULD LOOK EXACTLY LIKE THE FINISHED PUZZLE.</u>**

## STEP #2 - HAVE YOUR DRAWING APPROVED BY THE TEACHER.

**- If your drawing is approved the teacher will give you a 5"x7" piece of Styrofoam.**

**Business Sense**
John D. Hickey 1996

Date: ____________ Period: ______

Page **2** of **2**

**Make the Solution for this problem [create a prototype]:**

Step 4: **Each team:** Use the computers and the ClarisWorks program to CREATE a page of eight business cards. Use the stationery file named F&CS business cards. It is found in the "Clips" folder.

Step 5: **Each team:** TEST your solution by giving the "proof" to the client for their approval.

Step 6: **Each team:** REDO your business cards if necessary to fulfill the needs of your client

Step 7: **Each team:** Create two laminated cards for FINAL PRESENTATION .

Step 8: **Each team:** Completed EVALUATION PACKAGE turned in on time.

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Sample Business Card - twice normal size

**Evaluation:**

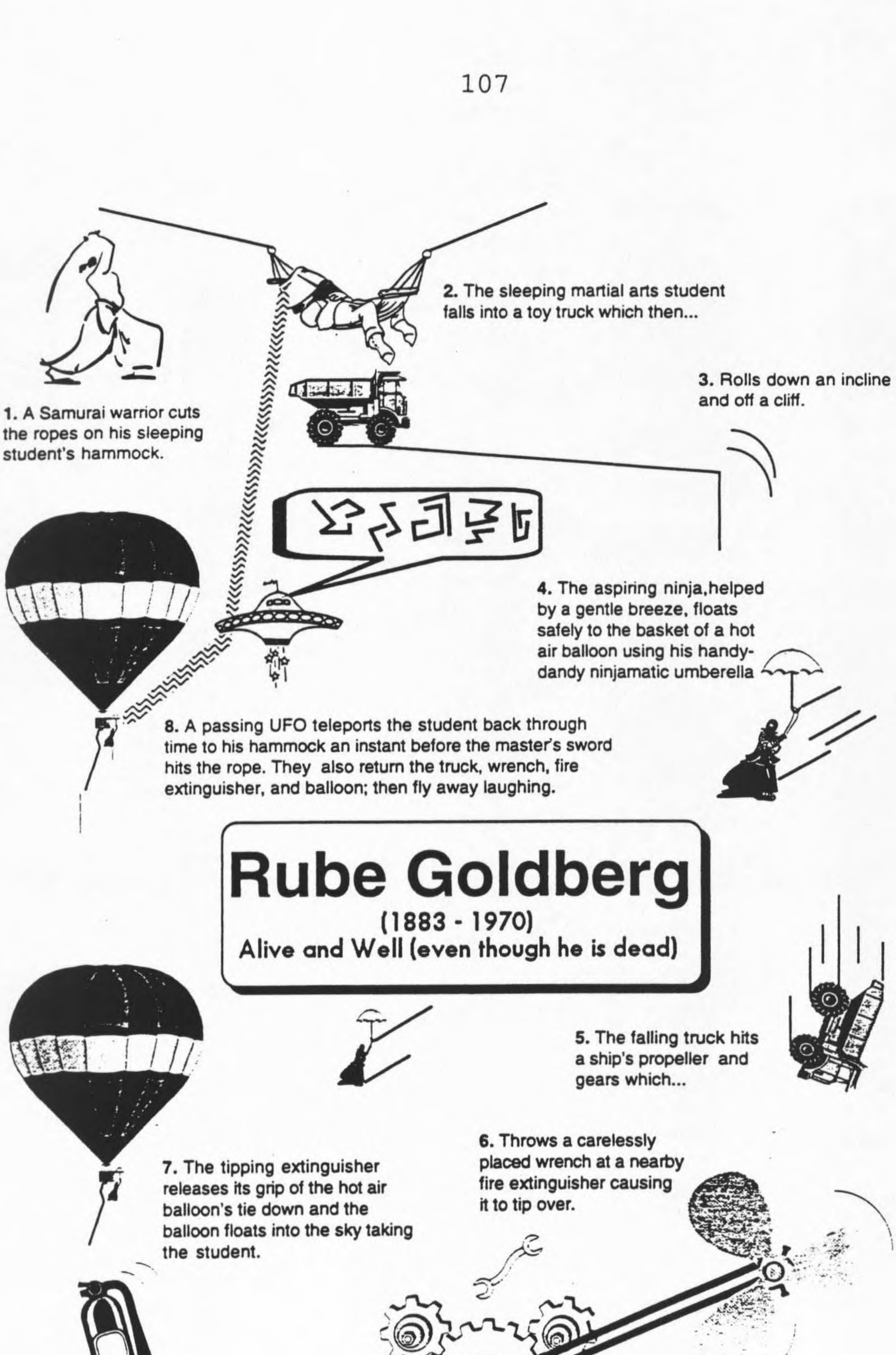
Each graphic design team is required to create a **presentation package** that contains:

- [ ] A page with each team member's two sample business cards attached (12 pts possible)
- [ ] Each team member's idea sketches (12 pts)
- [ ] A paragraph written together telling how your team chose to do the card you did (12 pts
- [ ] A page of 8 rough draft cards proofed and "signed" by your client. (12 pts)
- [ ] A final laminated card individualized for each client (12 pts)
- [ ] An evaluation sheet completed by your client (12 pts)

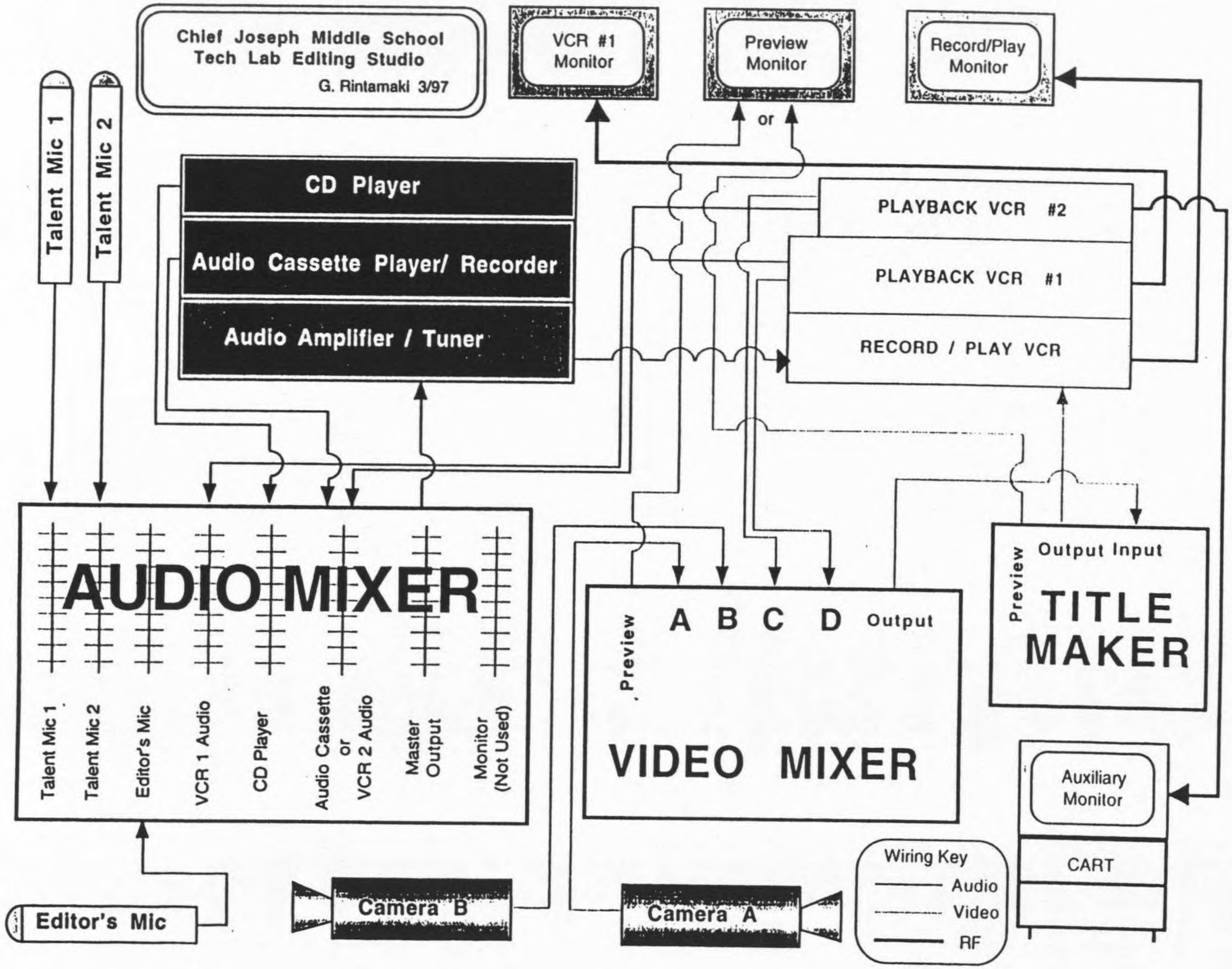
_______**Total points**

12 = A+ ; 11 = A ; 10 = A- ; 9 = B+ ; 8 = B ; 7 = B-; 6 = C+; 5 = C ; 4 = C- ; 3 = D+ ; 2 = D ; 1 = D- ; 0 =F

Developed and Written by
TechKnowledegy Inc.



1. A Samurai warrior cuts the ropes on his sleeping student's hammock.
2. The sleeping martial arts student falls into a toy truck which then...
3. Rolls down an incline and off a cliff.
4. The aspiring ninja,helped by a gentle breeze, floats safely to the basket of a hot air balloon using his handy-dandy ninjamatic umberella
5. The falling truck hits a ship's propeller and gears which...
6. Throws a carelessly placed wrench at a nearby fire extinguisher causing it to tip over.
7. The tipping extinguisher releases its grip of the hot air balloon's tie down and the balloon floats into the sky taking the student.
8. A passing UFO teleports the student back through time to his hammock an instant before the master's sword hits the rope. They also return the truck, wrench, fire extinguisher, and balloon; then fly away laughing.
Rube Goldberg
(1883 - 1970)
Alive and Well (even though he is dead)



Chief Joseph Middle School
Tech Lab Editing Studio
G. Rintamaki 3/97
VCR #1 Monitor
Preview Monitor
or
Record/Play Monitor
Talent Mic 1
Talent Mic 2
CD Player
Audio Cassette Player/ Recorder
Audio Amplifier / Tuner
PLAYBACK VCR #2
PLAYBACK VCR #1
RECORD / PLAY VCR
AUDIO MIXER
Talent Mic 1
Talent Mic 2
Editor's Mic
VCR 1 Audio
CD Player
Audio Cassette or VCR 2 Audio
Master Output
Monitor (Not Used)
Preview
A B C D
Output
VIDEO MIXER
Preview
Output Input
TITLE MAKER
Auxiliary Monitor
CART
Editor's Mic
Camera B
Camera A
Wiring Key
Audio
Video
RF

# Tech. Ed. 7 Assignment

Mr.Rintamaki '95

Page 1 of 2

# "HOW STUFF WORKS"

**Introduction** - In this assignment you will research how some common technological device works, then report your findings to the class in the form of a video report. You must do this assignment in teams of three or four students. You may pick your partners, or if you wish I will assign you to a team.

## Directions :

**1.** Begin this assignment by selecting a common technological device such as a vacuum cleaner, electric drill, hair dryer, etc. to research. The device must be a man made object, have at least 2 moving parts or be powered with electricity and be able to be researched using the books in the Tech room library.

**2.** Research how your selected device works. Here are a few suggestions for doing this:

A. Use the classroom library reference books.

B. Use the reference books in other libraries.

C. Ask your parents or other adults. (They may know more than you think!)

D. Take an old discarded or broken device apart. (Ask for permission and supervision before you do this, some things are **dangerous** to take apart !

**Make sure that you understand how the device works before going to the next step!**

**3.** Create a story board of your production. (See example on the bulletin board.) This MUST be turned in before you will be allowed to tape your production.

**4.** Create scripts, cue cards, diagrams, models, props, etc. as needed for your production. **Note**: Inorder to build a model in the production lab, you must first convince the instructor that a model is good way to explain your device then make a technical drawing of your proposed model.