8613268

Bancroft, Beverly Anne

A CHILD'S PRESENT IN A FUTURES-ORIENTED SOCIETY: HOW SELECTED MICHIGAN PUBLIC ELEMENTARY SCHOOLS PROVIDE INSTRUCTIONAL COMPUTING OPPORTUNITIES FOR THEIR PUPILS

Michigan State University PH.D. 1986

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark __√__.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print ______
3. Photographs with dark background _____
4. Illustrations are poor copy ______
5. Pages with black marks, not original copy ______
6. Print shows through as there is text on both sides of page ______
7. Indistinct, broken or small print on several pages __✓__
8. Print exceeds margin requirements ______
9. Tightly bound copy with print lost in spine _______
10. Computer printout pages with indistinct print ______
11. Page(s) __________ lacking when material received, and not available from school or author.
12. Page(s) __________ seem to be missing in numbering only as text follows.
13. Two pages numbered ______. Text follows.
14. Curling and wrinkled pages ______
15. Dissertation contains pages with print at a slant, filmed as received ________
16. Other ____

____

____

A CHILD'S PRESENT IN A FUTURES-ORIENTED SOCIETY: HOW SELECTED MICHIGAN PUBLIC ELEMENTARY SCHOOLS PROVIDE INSTRUCTIONAL COMPUTING OPPORTUNITIES FOR THEIR PUPILS

By

Beverly Anne Bancroft

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Educational Administration

1985

ABSTRACT

A CHILD'S PRESENT IN A FUTURES-ORIENTED SOCIETY:
HOW SELECTED MICHIGAN PUBLIC ELEMENTARY
SCHOOLS PROVIDE INSTRUCTIONAL COMPUTING
OPPORTUNITIES FOR THEIR PUPILS

By

Beverly Anne Bancroft

The purpose of this study was to describe selected policies and practices present in a sampling of 600 Michigan rural, suburban, and urban public elementary schools which influenced the local availability of microcomputers for students, the level of student access to and participation with electronic learning, and the educational uses of microcomputers made by both teachers and students. The study was prompted by the need to gather and use baseline data emerging from the first significant five-year period of microcomputers in school settings, 1980-1985.

Three surveys were conducted tc gather observations by computing experts regarding characteristics of high-usage schools, information from a large random sampling of elementary school principals concerning local uses and numbers of computers, and interview data from teachers and administrators providing descriptions and in-depth analyses of educational computing activities at six selected sites.

The average number of microcomputers across all schools sampled was eight. When averages were set aside, however, the data indicated a wide-ranging computer distribution and disparate student access and participation opportunities across all community types.

Regardless of the numbers of computers owned, most schools have developed an instructional plan and share a belief about the essentiality of computing opportunities for elementary students. Each school community used traditional, frequently accompanied by entrepreneurial and grass-roots means to provide for students what was deemed to be an appropriate curriculum.

School characteristics, other than funding, that appeared to facilitate a high-access and participation program for both students and teachers included principal leadership and involvement, ongoing and targeted local staff-development interventions, a local computer "buff," enthusiasm for and commitment to the concept, and creative uses of time and equipment.

The potential value of this study lies in its future replication at the elementary level and its administration to Michigan middle/ junior high schools and high schools for purposes of noting present practice and evaluating equitable outreach to all students.

ACKNOWLEDGMENTS

Appreciation is extended to the members of my doctoral committee: Richard E. Chapin, Director of Michigan State University Libraries; Edward D. Roeber, Michigan Department of Education, Director of Michigan Educational Assessment Programs; and to Professors in the Department of Educational Administration: Lawrence W. Lezotte, co-advisor of the dissertation; James L. Page; C. Robert Muth; and Louis Romano, program advisor.

Special thanks to the following educational computing researchers, practitioners, elementary principals, and statistical data experts, whose input was invaluable at various stages of the document's preparation. Educational computing experts: Lucy Ainsley, Larry Alexander, Ann Deke, Elaine Didier, Joan Fairey, Cass Gentry, Carolyn Gilbreath, Margaret Schmidt, Wayne Scott, Lary Smith, Grace Snyder, Ron Wimmer, and Karl Zinn; computing consultant experts: Joan Burleigh and Lynn Allen; principalship experts: Louise Birch, David Dean, Janet Koepke, Ron Lott, and Jean Marlowe; and data and design experts: Michael Ward and Lawrence Lezotte.

Important technical assistance at various phases was provided by David Donovan, Assistant Superintendent, Michigan State Department of Education, and Patricia Slocum, Michigan Department of Education; Molly Bancroft, Sue Cooley, Paty Gould, G. Sutherland Hayden, Lorraine

Hull, Kent Leach, Phyllis Music, and Frank Womer. Collegial support was ever present from Michigan State University professors: James Costar, Howard Hickey, Joe Levine, James Snoddy, and Louis Stamatakos; and from Connie Stoelton, University of Michigan; Jack Minzey, Eastern Michigan University; Mary Jo Lomas, Dearborn Public Schools; Karen Mercier, Birmingham Public Schools; and Robert and Caryl Ferguson, Ferris State College.

A spiritual undergirding, sustaining the effort, came from the members and friends of Christ's Ecumenical Church, Traverse City, Michigan.

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Page

CHAPTER I

BACKGROUND

Introduction

In communities across the United States, individual public schools vary in both their commitment to and resources for providing instructional computing opportunities for their students (Komoski, 1984). Even when an effort is put forth, it varies in kind and magnitude within a school, across school sites, in districts, and across states (Lautenberg, 1984).

Recommendations urge that students be accorded access and participation opportunities for learning with and about microcomputers, and about the technological understandings and applications necessary to become part of an informed and participative citizenry. An equitable delivery of appropriate instructional computing opportunities has been encouraged from the federal level (National Commission on Excellence in Education, 1983); by heads of state governments (Council of Chief State School Officers Resource Center on Sex Equity, 1984); by business and industry (Goldberg, 1984; Meyers, 1983); by professional education organizations, for example, the National Council of Teachers of Mathematics (1984) and the International Reading Association (1984); and by interested citizen groups (American Association of University Women, 1985; National Committee for Economic Development, 1985).

Just how to use computers in school settings, both to the students' advantage and cost effectively, has recently become one of the most pressing questions advanced by educational planners (Association of Supervision and Curriculum Development, 1985; Klein & Strother, 1984).

Concern about the child's life in a time of rapid technological change, and children's interaction with computing as an aspect of that change, have been discussed by Greenberg (1985), Hayes (1967), and Zimiles (1985). Almost 20 years ago, Hayes wrote of the computer as a "powerful tool to aid in stimulation of imagination, creativity and problem solving," but requiring "the imaginative and creative efforts of those most concerned with children as individuals (and not as response mechanisms) to see in what ways it can be so used" (p. 260).

Although instructional computing has a 20-year history in public schools (Koetke, 1984), the early years of educational computing activities reached proportionately few of the nation's students or teachers. It was only after 1980 when the more adaptable and cost-efficient desk-top microcomputer evolved and proliferated that instructional computing applications and school uses of microcomputers achieved a national focus (Ferres, 1982; Wright, Melmed, & Farris, 1982).

The microelectronic or "high tech" age in which students are receiving their formal education is characterized by rapid change and innovation. Microcomputers are only one such innovation (Hall, 1981). The sheer number of microcomputers present in school settings has more than doubled in the past year. And, from 1983 to 1984, the number of schools with at least one microcomputer has increased from 24,696 to 55,765 in the nation's 81,506 public schools (Market Data Retrieval, 1984).

Statement of the Problem

The rapidly changing events of the "high tech" age have transformed the lives of all citizens of Planet Earth (Shane, 1983). Presently, public schooling is embroiled in two major, yet not disparate issues: (a) calls for major educational reform (Passow, 1984) and (b) a press to "retrofit" to embrace the newer technologies (Shane, 1981). While a number of analysts have discussed this turmoil in terms of reestablishing the United States's dominance in the world marketplace, others have viewed the crisis as an opportunity to develop a learning-oriented society through the promotion of lifelong learning (Berman, 1984).

Even as the debates about national education reform and the assimilation of the newer technologies flourish, the majority of children in America continue to experience their 13 years of education in the context of a historically traditional public school setting (Leonard, 1984).

The responses policy makers choose for either educational reform or for "retrofitting" have a direct effect on today's students and teachers. Zimiles (1985) noted the complexities this entails for educators: "The multifaceted character of educational goals leaves the teacher with nagging feelings of not having done enough" (pp. 17-18).

He pointed to a steady stream of change in policies, curriculum, and change even "within the children themselves."

In discussions of his book Mindstorms, Papert (1980) viewed computers in education, when used advantageously, as "carriers of powerful ideas and of the seeds of cultural change," permitting children to discover, think, and learn in new and integrative ways. His extensive studies and those of his colleagues have tended to confirm these premises.

> But there is a world of difference between what computers can do and what society will choose to do with them. Society has many ways to resist fundamental and threatening change. This book is about facing choices that are ultimately political [emphasis added]. (p. 5)

Buffie (1984) reported, "History documents that educators tend not to be proactive" (p. 111). But society has demanded a response from public education to address the new technologies. The present study sought to contribute information to an as-yet insufficient body of knowledge about how educators and policymakers generally have addressed the issue of providing all students with educational opportunities relevant to new technologies (specifically microcomputers) and what educational uses have been emphasized.

The problem focused on in this descriptive study concerns if and how local schools have initiated educational computing efforts even in the absence of both clear mandates and adequate resources. Koetke's (1984) words clarify this focus: "Certainly there is much research to be done regarding the application of computers to the learning process, but there is nothing to be gained and much to be lost by using that as an excuse to do nothing today" (p. 163).

Purpose

The purpose of this study is to describe selected policies and practices present in a sample of Michigan public rural, suburban, and urban elementary schools that relate to the integration and implementation of instructional computing activities for students. Of interest are the depth and breadth of student access and participation opportunities, the kinds of educational applications present, and the local elements noted or cited that helped characterize a local elementary school microcomputer education effort.

It is also of interest to locate and study in somewhat greater detail a few elementary schools that appeared from the data to evidence a high degree of access and participation opportunities for both students and teachers and to describe the context in which facilitating characteristics seemed to occur.

An intention of this study is to attempt to provide for educational planners information that might serve as an indicator of present progress toward a general integration of educational computing across community types and across grades in Michigan public schools.

Need for the Study

There are currently thousands of microcomputers in place in public schools. Local school staffs, districts, educational agencies, professional organizations, and concerned groups have adopted various actions to promote K-12 instructional uses of computers. Consequently, a variety of uses, levels of integration, and access opportunities are provided for students across school sites. "There is no typical way schools use computers in the curriculum because the technology is so new and has been introduced into schools in such a disorganized fashion" (Report on Education Research, 1985, p. 8).

While some schools are only now acquiring their first computer and a few pieces of instructional software, other schools have implemented highly sophisticated K-12 programs, with a documented philosophical commitment to promote a full range of student and teacher competencies.

By the very nature of the loosely coupled American educational system, which Howe (1983) called the "nonsystem" of education, there has already resulted a disparity in the provision of instructional computing opportunities for students. Local schools may choose to, or not to, engage in microcomputer education; they ultimately decide which students will have the opportunities and what uses will be promoted. Any computer-related implementation decision involves a financially costly and long-term process, involving even more than the acquisition of courseware, hardware, the training of staff, and the educational plan (Gray, 1984; Guertin, 1983). Moreover, it requires school leaders to develop a program in the context of a continually changing technology accompanied by shifting expectations from society.

The need to determine the present level of integration of instructional computing activities in Michigan schools was verified by the Michigan State Board of Education (1984) in the Blueprint for Action:

> The Michigan State Board of Education (1984), based on the recommendation of the referent technology group shall . . . acquire existing school district plans in order to develop and provide planning models for school district and intermediate district use [and] evaluate the levels of computer literacy within the state [emphasis added]. (pp. 21-22)

The status of computer literacy among secondary and elementary school students is a question of national interest. The National Center of Education Statistics (Lockheed, Hunter, Anderson, Beazley, & Estey, 1984) and other national groups gathered together experts in educational computing to design a questionnaire for school self-study that would assist local districts in assessing their individual progress with integrating this new technology. The results of their work, The Computer Literacy Assessment Instrument, revealed the magnitude of the task and also the vital need for schools to plan for students those computer-related activities that are based on the best of currently available information from research and practice.

The need for this study was undergirded by the assumption that when educators are about to launch a new program, they are most anxious to make rational, technical decisions based on good, practical models or research (Cuban, 1984). To provide an issues-oriented overview of the topics that presently confront instructional computing policy makers, experts have urged a "healthy dose of planning," based on current research, practitioner experiences, and an analytic anticipation of future technological requirements.

Even though the rate of implementation of microcomputers into public education is uneven across school sites, educators must accept the reality of their ultimate integration into school settings (National Council of Teachers of Mathematics, 1980).

Sheingold, Kane, and Endreweit (1983) used the case study method to gather information on instructional computing in schools and verified the need for further research.

> Yet, in 1983, there is not much more knowledge than there was in those pioneering districts in 1980 about the educational outcomes of using microcomputer technology for instruction. Indeed, given the accelerating rate at which schools are purchasing microcomputers, the problems have intensified. (p. 153)

From a baseline knowledge and the continued documentation of important developments in the use of this technology in schools, it will be more possible to build effective models from which local schools may draw ideas and formulate plans to fit their local needs (White, 1984).

The present study is, in fact, an offshoot of a previous field-based research effort of a year's duration. "How Three School Systems in Southeastern Michigan Integrated Microcomputing Into Their Instructional Programs" (Bancroft, 1983a) stressed the need for further research in Michigan schools.

Hall (1981), whose work with change models has provided a useful framework for institutional change, recommended nine steps that need to be considered by those who study microcomputing implementation in schools.

> With regard to all nine, one overarching recommendation is that emphasis be placed on more descriptive studies [and] studies which

> emphasize development of hypotheses and theory building, not just the development, but extend descriptions of what has happened. (p. 17)

School staffs have recently come to rely more on field-based research to guide their school-improvement practices (Justiz & Mason, 1984). They also send staff members to visit schools where activities of interest can be reviewed (Bancroft, 1983b).

When Johnson (1983) studied how schools acquired their instructional-computing agenda of action, he reported a certain cycle of activity common to all sites. Cory (1984) referred to identifiable stages through which schools pass in adding microcomputer instruction to the curriculum. These reports corroborated a commonality of implementation strategies across school sites, as schools individually work through the innovation/adoption processes. Such findings have reinforced the premise that a school's implementation process can be facilitated by knowledge of the documented practices and progress evaluations extracted from demographically similar schools (Hall, 1981).

Becker (1982) corroborated the need for further research as a basis for more reliable decision making both by local schools and for product developers:

> For each of the problems that may result when microcomputers are introduced into the school's ongoing educational structure, systematic research could help discover their incidence and severity and the conditions under which the problem is minimized.
>
> We need to develop an unbiased and representative body of information about how schools decide to obtain and use microcomputers and other technological tools, how they use them, and the effects their use has on students and the social organization of the school.

> However, in the absence of research, those who implement various uses of microcomputers in educational environments should share with other educators how they deal with them. (p. 56)

Research Objectives

The purpose of this study was to collect descriptive data, systematically, statewide, which would provide information on the kinds and levels of student use of instructional computing policies and implementation practices prevalent in Michigan public elementary schools.

The four major research questions dealt with (a) the level of integration of microcomputers across rural, suburban, and urban elementary school sites; (b) the levels of access opportunities for most students within a school; (c) the kinds of educational uses prevalent within and across schools; and (d) the policy decisions that are being formulated or are in place to implement educational computing activities.

Fourteen ancillary questions were included. For example, principals were asked what specific funding sources were used, if staff training and updating were provided, if educational objectives were in place, if and what external technical assistance was used, and where school computers were located. In addition, three role-specific interview questionnaires were prepared to administer to a principal, two teachers, and a computing consultant or central office administrator at six selected high access/use school sites. The educators' responses, coupled with on-site observations, enriched the research and permitted discussion of any local characteristics that seemed to contribute to a climate of high student access and participation opportunities with microcomputers. It was anticipated that these reinforcing attributes, in addition to any notable success-oriented local policies and practices, might be usable findings for schools planners initiating computing activities.

Design

This two-tiered study is descriptive in nature, using the survey technique. The research objectives were incorporated into questionnaires. The first questionnaire was broadly distributed by mail to 600 elementary school principals across an equal sampling of rural, suburban, and urban elementary schools. The second tier of the study used questionnaires to gather information at six elementary school sites. Preceding these exercises was an opinionnaire sent to 17 computing experts who provided specific input of value in formulating purposeful investigative direction for the entire study.

Good and Skates (1957) described the nature and value of descriptive research in the following way:

> Much of the significance and importance of the descriptive study lies in the possibility of investigating the status of conditions at any given time and of repeating the survey at a later date, thus providing descriptions of cross-sections at different times, in order that comparisons may be made, the direction of change noted and evaluated and future growth or development predicted. Such guidance is of relatively great importance in our complex and rapidly changing modern society. (p. 550)

The six on-site visitations provided an opportunity to administer an interview questionnaire to the principal, two teachers, and one district administrator. While these brief interviews did not allow for detailed observations, the responses to the questionnaire items did provide richer information than was possible to derive from the statewide survey questionnaire. Slavin (1984) discussed the limitations and advantages of the interview method of data gathering. Taken in the aggregate, these case summary interviews offered information and perspectives available only from educators working directly with both implementation problems and promising computer-related practices.

Population and Sample

An initial questionnaire was sent to principals of 600 Michigan elementary schools, approximately one-fourth of all public elementary schools. The schools sampled in this study were drawn from the lists of community types developed by the Michigan Department of Education (1971). The schools, randomly selected, were from five strata grouped into urban, suburban, and rural community types: Urban I, Tri-County, which includes Wayne, Oakland, and Macomb grouped with Urban III, Urban Outstate; Suburban II, Town and Urban Fringe of Tri-County Area, grouped with IV, Urban Fringe, Outstate; and Rural. (See Appendix A for definitions of Michigan school districts by major community type and a map indicating region and community-type categories.)

The staff of the Office of Technical Assistance and Evaluation, Michigan Department of Education, gave guidance in the elementary school selection process and in formulating computer-related questions that might provide needed answers for educational agency planners. (The description of selection processes may be found in Chapter III.)

Methods and Procedures

Before the present study, a field-based research was conducted (Bancroft, 1983a). It described how three K-12 school systems in southeastern Michigan integrated instructional computing into their schools. The chronology of those activities served to illuminate certain elements within the context of the individual schools that appeared to foster high student access and participation opportunities. The notion of local facilitating characteristics found further verification in the results of an opinionnaire prepared and disseminated before initiating the present study. (See Appendix B for information on the opinionnaire.) The opinionnaire was mailed to 17 instructional computing experts who were asked to describe or name characteristics they believed would be present in a school where a high degree of access to and participation in instructional computing experiences was present for students. Their responses, unweighted, were listed and ranked according to those attributes most frequently mentioned. These characteristics were used to help formulate pertinent and appropriate questions for the statewide mail questionnaire and the on-site interview questionnaires. (See Appendix B for sample questionnaires.)

The statewide mail questionnaire was developed to provide general information about the implementation, integration, and uses of instructional computing in Michigan elementary schools and to serve subsequently as a vehicle for discovering school sites where there was supportive evidence of a high degree of student computer access and educational usage.

The second set of instruments were computer-related, role-specific questionnaires for use when interviewing local staff: the principal, a computing consultant, and two teachers. Questions in all instances were formulated from examples in the related literature or from the input of educational computing experts.

Schools selected for on-site visitation met criteria set forth for indicating high-access and high-use opportunities for most students and, in addition, broad applications. (See Chapter III for a discussion of criteria.)

To ensure the appropriateness of all inclusions in the statewide questionnaire, five acting computing teachers or computer consultants reviewed the content. The revised questionnaires were pilot tested by elementary principals for appropriateness and ease of completion for the respondents-at-large. (See Appendix B for letters to experts.)

In addition to computer education experts, the following documents were used to frame research and survey questions: the Rand Study, "Successful" Teachers' Patterns of Microcomputer-Based Instruction (Shavelson, Winkler, Stasz, Feibel, Robyn, & Shaha, 1984); Computer Literacy...Assessment in Schools (Lockheed et al., 1983); Hall's (1981) synthesis recommendations described in "Issues Related to the Implementation of Computers in Classrooms"; and the Montana Office of Public Instruction's (1983) sample worksheets and surveys.

Suggestions for developing the questionnaires' formats were found in Designing and Utilizing Mail Questionnaires in Educational Research (Humphries, 1983). Overall guidelines for developing the design were derived from Summing Up (Light & Pillmer, 1984).

Hall's remarks about the microcomputer's future and long-range potential influenced the methodology selected for this study:

> My recommendations would be that few of the limited funding resources be invested in dissemination per se. Rather, these resources need to be invested in further research and development efforts around software and exploring issues in relation to implementation of microcomputers in different kinds of school settings.

Assumptions or Limitations

1. It was assumed that a majority of elementary schools would be making a local effort to provide some kind of educational computing exposure or activity for students.

2. It was assumed that Michigan elementary school progress in microcomputer education implementation would be similar in direction to that reported for elementary schools generally.

3. It was assumed that variations in the kind and provision of educational computing opportunities would occur across and within districts and even within schools, whether schools are rural, urban, or suburban.

4. The study was limited by time and by available funds to only a sampling of Michigan public elementary schools.

5. The study was limited to self-reporting survey questionnaires mailed to principals, and three of similar content

administered to a few educators at six school sites. Generalization from such self-reported survey and interview data provides a window in time but lacks the validity of a controlled study.

6. With the implementation of a new technology and even with the local school's best efforts to accommodate the change comes a simultaneous absence of expectations about what might or should be present to evidence that effort.

Definition of Terms

The following terms are discussed as they are used within the parameters of this study.

Access. The term "access" as it refers to the linking of a computer's memory through a programming language is not applicable. Access refers herein to the effort of schools to provide most students with an opportunity to work with computers in educationally supportive ways.

Chapter I. Federal funds distributed through state agencies and allocated to help the lowest-achieving students with improvement of basic skills. Purchases designated only for use of those students.

Chapter II. Federal funds distributed through state agencies to augment local school instructional projects.

Computer literacy. A term widely used, but whose meaning has rarely been agreed upon. Lockheed et al. (1983) described it as:

> Whatever a person needs to know and do with computers in order to function competently in our information-based society. It includes three kinds of competence: knowledge, skills and understandings: (1) the ability to use and instruct computers to aid in learning,

solving problems, and managing information; (2) knowledge of functions, applications, capabilities, limitations, and social implications of computers and related technology; and (3) understanding needed to learn and evaluate new applications and social issues as they arise.

Courseware. See Software.

Equity. Moursund (1984) described equity as "emotion laden" and meaning different things to different people. Essentially, equity is the provision of something equally and fairly to all concerned.

Hardware. The components of the computer, including the display monitor, the keyboard, disk drives, printers, and so on.

High-tech era, new technologies, microelectronic age. Terms that help describe the present time in society as it is affected by numerous scientific breakthroughs.

Instructional computing, educational computing, electronic learning, and microcomputer education. Terms used interchangeably to direct the focus of the computer as one tool for student learning, when used with appropriate software and in a planned and guided context.

LOGO. A sophisticated programming language whose creators have developed special programs whereby children may have computer experiences that enhance such skills as problem solving, procedural thinking, recursion, debugging, and graphing.

Networking. Linking computers and/or data bases for retrieval or interactive communication; or staffs or schools sharing human or materials resources to enhance local programs.

Software. The instructions and programs that are used in the computer; also, courseware.

Use and participation. The word "use" has two meanings in this study. The first has relevance to student use of and access to school computers. Lezotte (1984) emphasized that the mere presence of computers, even in an open setting, may not insure fair use across groups and grades. High use and participation in this study imply the effort to provide appropriate settings, access, and use time.

The other meaning of use in this study means educational usage, that is, the uses that engage students within a given school. Educators have spent time, effort, and money acquiring computers. More time, Alvarado (1984) suggested, should be given to planning for the best uses of those computers within schools. "All students should learn to use computers in a variety of ways, and understand the relationship of microcomputers to society" (p. 14). Use, many computer educators would agree, is more important in many ways than numbers of computers present in schools.

High use and participation in this study implies making computers available as much of the time as possible to the most students possible, and progressing toward broader applications of computers across curriculum content areas.

Summary and Overview

Chapter I established the need for the study. It portrayed the necessary steps and rationale for determining the level of integration of computers and software into a sample of Michigan public elementary schools, the access and participation opportunities, and levels of educational usage currently prevalent for students. It indicated the need to define what local policy decisions and facilitating activities must accompany such an implementation. The means selected to address the concerns of interest in the present descriptive study were set forth.

Chapter II, the review of literature, contains selected issues and concerns in five computer-education-related areas: (a) society, technology, and calls for change; (b) an overview of the integration and implementation of K-12 educational computing; (c) a discussion of student learning, either with or about computers; (d) a summary of some of the policy issues confronting educators planning the implementation of computing programs; and (e) an overview of the arrival of microcomputers and the integration of educational computing into Michigan public schools.

Chapter III outlines the methods and procedures used in this descriptive study and describes the survey instruments.

Chapter IV contains a review of the findings from the statewide mail survey of elementary schools and the on-site visitations to six schools.

Chapter V provides the summary of the research, followed by conclusions, recommendations, and reflections.

CHAPTER II

A REVIEW OF SELECTED LITERATURE

Although the acquisition of microcomputers and student opportunities for a variety of instructional computing activities, K-12, continue to increase, much remains to be learned and understood about this technological phenomenon. Five content-related topics are reviewed in this chapter: (a) Society, Technology, and Calls for Change; (b) An Overview of the Implementation and Integration of Instructional Computing Programs Into K-12 Public School Settings; (c) A Discussion of Selected Topics Related to Microcomputers and Student Learning; (d) Policy Considerations Confronted by Educational Planners Formulating Educational Computing Programs; and (e) A Brief Overview of the Arrival of Microcomputers and the Implementation of Educational Computing in Michigan Public Schools.

Society, Technology, and Calls for Change

The following subsections establish a framework for the effects of rapidly changing technology upon people in general, upon the social systems and various work settings, upon all systems that must keep pace, and upon the system of K-12 education specifically. Headings include (a) Society and the Changing Technology, (b) Technology and

Calls for Educational Change, and (c) Calls for K-12 Public Education to Reform and to Assimilate New Technologies.

Society and the Changing Technology

Von Puttkamer (1983) depicted the present times:

> We are living in the most dynamic generation since human beings began to evolve socio-cultural systems more than three million years ago. . . . Only a few generations were needed to create a situation that, historically, represents absolute novelty; for the first time in our evolution we are able to:
> * manipulate, control and change our own biological, genetic substance;
> * carry out collective self-destruction by interacting with elementary building blocks of our world;
> * create a world-wide communication and information network of an extent and effectiveness never dreamed of before; [and]
> * throw off the shackles of our planet in the course of spreading out in the universe.

The microcomputer is only one of the many transforming tools of the high-technology era. It was selected as the major focus of this study because its use and presence is widespread, and the computer represents one of many such recent technological innovations that influence the daily lives of many members of society, causing them to cope and adjust. Shane (1983b) called the microprocessor "both the source and support system for the transitions already underway."

Von Puttkamer (1984) observed that such new technologies appear to surface in quantum leaps, rather than as a steady, even force. "Individuals struggle to hold it back for as long as it takes to assimilate it, to digest it and understand it, and to enrich it," indicating that a "pause is required by individuals for consolidation" (p. 4). Shane (1983a) told of a social disorientation that accompanies this kind of rapid change.

Naisbitt (1983) identified ten transformations that are present in society and said that none is so subtle "yet explosive" as the megashift from an industrial to an information society.

Sinclair (1984) questioned the prevailing meanings of "information society" or "information technology":

> But talk of information technology confuses an issue; it is used to mean people handling information rather than handling machines, and there is little that is fundamental in this. The real revolution which is just now starting is one of intelligence. Electronics is replacing man's mind, just as steam replaced man's muscle. (p. 257)

The shift from the "smoke-stack" industrialized society to the present "high tech" society transpired in only a few decades. It began when the potential of global communication by satellite became a reality with the launching of Sputnik in 1957. Subsequent networking developments have permitted the almost instantaneous transmission of information, creating an information economy.

Naisbitt (1983) reported that over 60% of Americans spend their working time creating, processing, or distributing information. Microcomputers and other technologies also change the fabric of social interaction. Whether one lives in a primitive, agricultural village or resides in a predominantly "high tech surround," there are evolving, almost daily, new options and challenges. For some individuals and countries, threatening implications are imposed by these emerging developments (Raymont, 1983). Shane (1983b) cited from his interviews that people are concerned about "whether or not human beings can cope fast enough to deal with the changes and problems that threaten them" (p. 12).

Boger, Blom, and Lezotte (1984) called for attention to the status and nurturance of children in a pressured, "high tech" society:

> The development of computers, communication satellites and television could serve to advance the agenda for our children, or they could become an ever-increasing part of the problem, as broadcast television is at the present time.
>
> The availability and dissemination of more information is clearly a "plus" for children, if it is used wisely. The problem is our children could become "information rich" and "experience poor." Who will help our children cope appropriately with the new information? Will it be available to all?

Apprehension has been expressed about the possible side-effects of a "high tech" society, such as machines replacing people or school settings that isolate students rather than socialize them. But Dwyer (1980) anticipated that "recent advances in technology . . . offer fascinating potential as agents for implementing a rich and quite deep view of education" (p. 87).

Agresto (1981) said that taking "potshots" at technology will not help resolve the complex issues surrounding education. "If technology is not an independent fact but a cohort of our values, then the humanities and technologies have much to say to one another" (p. 7).

The rapidly evolving changes in society caused by technology were summarized by Lewis (1983):

> There is a period of time apparent in all history when the rate at which tools have been developed outstrips the rate at which subsequent human adaptation to use such tools takes place. The present era, with the concomitant pressures of automation upon the individual and the accelerating trend of technological development appears to be such a time. In years to come, it is predicted that human beings will be forced toward acceptance of and adaptation to these kinds of changes in an unnaturally short time, perhaps more than once during their working life. (p. 87)

Technology and Calls for
Educational Change

By 1990, Juliussen (1984) predicted that the home computer market would total nearly $14 billion. Presently 15% of American homes have a personal computer for family use. Pogrow (1982) anticipated that by 1985 computers would be part of eight million homes. The business sector was reported to be actively using about three million microcomputers in 1980 (Molitor, 1981).

Greenes (1981) estimated that the computer, in some manner, would be the primary work tool of as many as 50% of the United States' work force. Computer and computer-related products are in themselves a continually growing and at the same time maturing industry, which reconfigures as its latest products become marketed (Anderson, 1984).

But as computers become infiltrated into daily life, the number of high-technology occupations will account for only 7% of the new jobs created during this decade. Educational forecasters Levin and Rumberger (in Hollifield, 1984) projected that while future citizens will require a broad understanding of technology, its effects, and its applications, they will not require "high tech" vocational training.

Raymond Reisler (19844), an American Can Company executive, believed the skills of most value to students are those that will transfer, those that stress problem solving and strategies for adapting to change. Current technical job skills may become quickly obsolete. "Most people now change employers three, four, perhaps five times . . . and most people that stay with one or two employers . . . have their job changed within that company several dozen times" (p. 5).

People in all walks of life continue to be influenced by the microelectronic revolution. People who bank electronically, view a space shuttle lift-off, or play a video game have frequent interactions with computers in their daily lives, but may not stop to consider or reflect upon their present or future involvement. Sinclair (1984) said, "It often seems that each new step in technology brings misery rather than contentment but this is because it brings change faster than benefits--and change, though often stimulating, is always disturbing" (p. 257).

If technology is destined to change the way American people live, learn, and work, then educational reform and reeducation have become essential policy considerations (Shane, 1981).

Hall (1981) confirmed that most individuals react to an innovation, such as microcomputers, through a sequence of behaviors. These "stages of concern" and the change process, he emphasized, must be understood by those with responsibilities for implementing computer education programs. The stages (Hall, Loucks, Rutherford, & Newlove, 1975) include the individual's first awareness of the innovation and culminate when the person is able to make applications of it, even to the extent of enhancing his personal or professional life.

Entire groups, even when apprehensive about assimilating a new technology, can be helped to a more rapid and propitious adaptation through planned intervention and continuing education. "The adoption of microcomputers must be understood as it occurs within each site, as well as nationally" (Hall, 1981, p. 18).

For decades the common perception of American education has been a formal and separate process that occurs within a given period of time. A child who attended school during her/his peak learning years was destined to graduate to use that accumulated knowledge in the industrialized society during his/her peak production years.

Experts have now predicted that interventions called "recurrent" education, in addition to on-the-job retraining, will comprise a lifelong education for workers (Hollifield, 1984).

Industries have already adopted automated processes, including extensive applications of robotics. Allen (1984) noted that "fewer workers are employed, and those that remain require higher-level skills and greater versatility. . . . Knowledge is becoming a major commodity and source of power" (p. 1).

For 30 years the large number-crunching tasks common to both government and big business have been accommodated easily on the giant main-frame computers (Futkowski, 1984). It has only been in the last five years that smaller businesses and units of government have looked to technology to accomplish such tasks by using the less expensive and more adaptable microcomputers. But unlike the large public and private sector operations, the small businesses have inadequate local financial or teaching resources for the retraining of their employees in data-based management, accounting processes, information retrieval, or spreadsheet analysis. Consequently, these employers expect their employees to go back to school or emerge from public school with a sense of the current technologies and to be to some extent "computer literate."

Reisler (1984) acknowledged the need for technical skills and incremental change but encouraged educational planners to provide opportunities for students to think; to be visionary, flexible, and innovative; and to go beyond merely coping or trying to catch up with technology.

"The key to improved education is students, not computers," according to Moursund (1984a, p. 184), educational computing pioneer and authority:

> The goal is for everyone to become a self-reliant and independent learner. Computers can play a helpful role . . . and an increasing role as change agent, as well as within the curriculum. Far bigger improvements are possible if we can help students to take increased responsibility for their own education. (p. 184)

Whether justified statistically or not, training at the public school level and the postsecondary retraining of adults for the new technologies have surfaced as a virtual mandate from many segments of society. Educational planners who have confronted the call to keep pace with the new technologies, while also focusing on the long-term public good, have encountered not only ambiguities, but also the challenge of providing an action plan within institutions that have been historically slow to respond (Meyer, 1983).

When Shane (1981) talked about the essentiality of "retrofitting" individuals to take their proper place in the "Silicon Age," he focused attention on some ethical and social ramifications of the evolving times. In the global race to "retrofit," certain nations technologically have become sorted, as have numerous individuals and students, into groups called "haves" and "have nots." Komoski (1984) cited the current inequities between those who have computers and those who do not; and those who have access to learning with and about computers, and those who do not.

Any machine that produces such a monumental influence on people, places, and things, Goldberg (1984) said, "requires planning which not only incorporates the lessons of history, but also projects future prospects." He added that American citizens cannot afford to be computer illiterate. He recommended that businesses that have a stake in the future workforce must help public schools with the educational task.

How to prepare students of all ages to face the myriad social and knowledge challenges has become controversial. As one example, when a recent bill was introduced in the United States Congress to provide high-tech hardware to schools, M. Joan Parent, president of the National Association of School Boards, responded:

> Such gifts are the last things schools need to bolster their computer education programs. If it [the computer] does not fit into the teacher's instructional strategy for achieving the school district's curriculum, then it becomes a classroom toy. (Education Daily, 1984, p. 3)

A number of representatives of state, local, and national educational groups apparently concurred: "Schools first need help in training their teachers, developing curriculum and researching the impact of computers on students before they start wiring their classrooms for the information age" (Education Daily, 1984, p. 3).

<u>Calls for K-12 Public Education to Reform and to Assimilate New Technologies</u>

Currently United States public schools have been called upon to (a) reform their curricula and modes of operation (Dollar, 1984) and (b) prepare students for life in a "high tech" era (<u>Education USA</u>, 1982).

In recent years, but culminating in 1983 with what Howe (1984) called the "Year of the Reports," comprehensive studies of schools, such as those of Boyer (1983), Goodlad (1983), and Sizer (1984), were joined by several dozen task force and commission reform reports, including the widely publicized <u>Nation at Risk</u> (National Commission on Excellence in Education, 1983), initiated by then Secretary of Education T. H. Bell. Without exception the authors and members studied various aspects of school life or the schooling process and concluded that public education was in urgent need of immediate reform. A number of the task force recommendations said the major need for these comprehensive reform measures was to regain the nation's position of economic superiority, which involved retraining the workforce and upgrading the educational level of students to the perceived requirements of a "high tech" society, while at the same time bolstering citizen morale and boosting national security (Berman, 1984).

Most of the long-range studies and task force reports addressed the need to emphasize the basic skills and, in addition, to incorporate into the curricula a sustained emphasis on communication abilities, problem-solving expertise, higher mental process thinking, and computer technology-related understandings. The Nation at Risk specifically recommended one-half year of computer science for every student, a suggestion that generated both activity and controversy (Education Daily, 1984).

Many experts who pioneered in educational computing have speculated that instructional computing would, depending on availability of hardware and courseware for students and teachers, become a tool to facilitate and enhance the basics of reading, writing, and mathematical and scientific computation (Moursund, 1984). Luehrmann (1984) spoke of instructional computing as an ongoing process, with appropriate skills being presented and incorporated at the best teaching and learning moments for students. None advocated a quick computer-literacy "fix" as a panacea for catching up with technology. Some disagreed with the concept of requiring a half-year of computer programming or literacy for high school graduation.

Neither are all local schools reacting quickly to the wave of reform reports and calls for change. Passow (1984) described nine decades of not dissimilar reform movements growing out of crisis-oriented situations.

The reports have raised concern among educators that any changes made solely in response to new initiatives may be only cosmetic, inappropriate, or "too little and too late" (Leonard, 1983).

Before the current rush of mandates for general school reform and for "retrofitting" education for the "high tech," a number of the approximately 16,000 school districts were engaged in local efforts to improve, even during times of declining enrollments and human and financial resources. For example, rich case studies were cited by Edmonds (1982) of successful school reform and improvement efforts that began in the mid-1970s and continued to prosper into the 1980s (Lezotte, 1984a). Similarly, microcomputers and educational courseware were being accumulated by public schools in the early 1980s at phenomenal rates (Lockheed et al., 1983).

For the states and local educational institutions responding directly to the reform reports, Lezotte (1984a) cautioned: "One fear shared by many educators is that the current reform movement may turn out to be only enrichment programs for the relatively advantaged."

Koetke (1984) commented, in regard to instructional computing:

> Certainly there is much research to be done regarding the application of computers to the learning process, but there is nothing to be gained and much to be lost by using that as an excuse to do nothing today.

Wagshal (1984) interpreted the sustained attention of reformers on both electronic learning and school improvement as providing additional external support and enthusiasm for school-improvement activity:

> The coming decade may well be our last chance--our window in time--for determining whether computer technology will play a major role in our education institutions, or merely dominate our daily lives (as television does) while we ignore it in the schools. (p. 253)

Hollifield (1984) called the recent political focus on "high tech" in education a helpful circumstance, in that it reemphasizes the importance of education; however, he stressed that schools must resist the pressure to provide specific technological training that will only become obsolete. He referred to Stanford researcher Russel Rumberger's reminder of the real purposes of education, which include the preparation for careers, for citizenship, and for leisure time. "The computer should be used as a tool for learning, not as a subject that will displace more fundamental learning" (p. 3).

An Overview of the Implementation and Integration of Instructional Computing Programs Into K-12 Public School Settings Using Selected Examples

The current surge of activity and present level of integration of microcomputer education into public school settings can be attributed to local grass-roots efforts (Gray, 1984). If the estimate of a half-million microcomputers in public school settings by 1985 were a fact (Bork, 1984), then it could be said the phenomenon was a bottom-up event (Odden, 1984), generated a school or district at a time across states.

Market Data Retrieval (MDR) (1984) reported that in two years the number of schools with microcomputers had more than doubled. The percentage of districts using microcomputers rose from 41.7% in fall 1982 to 86.1% in fall 1983. While senior high schools led the way, the elementary schools revealed the most vigorous growth by tripling the numbers of computers on site in only one year. "Even schools that are usually 'low' spenders have made a great effort to bring microcomputers into their schools." MDR also pointed out that whether a school was urban, rural, or suburban did not seem to be a major factor in predicting which types of schools were accumulating computers. They concluded: "While there may still be a higher percentage of 'rich' schools with computers, the 'poor' schools have succeeded in becoming less computer poor." In addition, "states that appear to be leaders in terms of the number of computers owned are often below the national average when it comes to the number of students who must compete for each computer" (p. 1).

Estimates of the number of computers in American schools ranged from 350,000 to 550,000 in 1985 (Bork, 1984). Desk-top microcomputers only became available and economically feasible acquisition items for schools in the early 1980s. Almost without exception, this phenomenal growth has been reported in terms of numbers. However, this does not provide assessors with information needed to indicate the distribution of computers among students; the kinds, range, depth, or quality of the usage; the materials or software used; nor the professional resources employed to assure appropriate educational uses. Neither is information readily available about what issues are considered in the local implementation process, such as the commitment to funding or, as another example, the decision to treat computing as an appendage to the curriculum or to integrate it throughout the curriculum.

A National Institute of Education study (Shavelson et al., 1984) that looked at teaching behaviors of teachers who were exemplary users of microcomputers in mathematics and science instruction reported that although numbers of microcomputers appeared large, they translated into less than one for each school, making them largely inaccessible to most classrooms. Time for students to use the micros was also limited. "Educational applications of microcomputers do not come close to their potential; and even if availability and accessibility were not a factor, very few teachers have yet been educated to use them instructionally."

The report, entitled "Teaching Mathematics and Science: Patterns of Microcomputer Use," described three impediments to implementation: insufficient numbers of classroom microcomputers to make an educational difference; a lack of information about the best use of microcomputers and how to train teachers to use them; and a shortage of quality, curriculum-appropriate software.

Carnine (1984) cited three key variables that must be present to integrate computers effectively into the curriculum: (a) resource allocation, (b) quality software, and (c) implementation methods. When a school or district decides to implement an instructional computing program, experts recommend that an upfront policy analysis is essential if all roadblocks are to be addressed and overcome (Gray, 1984).

Dershimer (1982) named the following considerations when planning implementation strategies for microcomputers in public education: training, funding, choosing software, communicating with other users, matching local goals with the technology, selecting from the diverse applications, selecting hardware, and equitable use.

Cory (1983) provided a four-stage model for schools to use when developing a computer-implementation program: (a) "Getting on the Bandwagon," (b) "Stage of Confusion," (c) "Pulling It All Together," and (d) "Full Implementation." A few schools, she noted, are still at a pre-stage, wondering whether or not they should start.

Projects that have studied the implementation of K-12 microcomputer education include:

* The Mainstreaming Computers Project (Carnine, 1984) is a planning, developing, and implementing model that "addresses variables important to any effort to mainstream computers" (p. 78).

* The Sheingold, Kane, and Endreweit study (1983), in collaboration with the Bank Street College of Education and sponsored by the National Institute of Education, compiled information on the uses of computers in three geographically distinct school systems.

* The extensive and continuing studies at the Massachusetts Institute of Technology, led by Papert (1980), involved school children in usages of the powerful computer language, LOGO. Accounts may also be traced through the work of Pea (1984), Riordin (1984), Watt (1983), and more recently Fire Dog (1985), among others.

* Becker (1984a), in a series of reports on School Uses of Microcomputers (from 1983 through 1984), with an update (Chion-Kenney, 1985), has touched upon many implementation issues and has thus helped track the development of microcomputer education in schools.

* The Minnesota Educational Computing Consortium (MECC), while not a specific model of a school implementation project, has been a major force in school implementation of computer education in Minnesota. In 1973, a consortium of the State Department of Education, the University of Minnesota, the State University System, and the community

colleges formed to provide computing services in which a sharing effort was assessed as the most cost-effective method of delivery. At that time the giant main-frame computer provided hook-ups with hundreds of classrooms (Rawitch, 1982). Although the services rendered have changed over the years, the role of MECC has been expanded to provide not only resources and leadership within Minnesota but also elsewhere in the United States (MECC Bulletin, 1984-85).

* In 1981-82, six schools in Maryland and Virginia were studied to track the integration of computers into a K-8 curriculum (Hunter, Dearborn, & Snyder, 1983).

Moursund (1984a) addressed the challenges of implementation either on a district- or school-at-a-time basis by pointing to the massive size of the U.S. public education system, in which approximately 45 million students are enrolled in 100,000 public or private schools with two million educators and schools with school expenditures totaling well over $100 billion annually. Acknowledging the slowness of the public school system to change, Moursund questioned that the present expenditure of 1% of total school monies on precollege computing would have a significant effect on educational computing for all students.

State education agencies have recently become more involved in school-improvement efforts and the swing to address the new technologies. Lezotte and Bancroft (1985) reported 35 states with some kind of reform initiative. As a result many have urged their governors and legislatures to get involved in the uses of microcomputers and telecommunication systems in education. This is predicted to have a significant effect on activity at the local level over the next decade (Education Week, 1984).

West Virginia recorded its initial instructional computing activities evolving from a statewide educational network. The intention is to provide stronger instructional components to low-wealth districts, and especially to schools in the mountainous areas. West Virginia will boast the first statewide instructional computer network in the nation.

Access to instructional programs in all subject areas, statewide bulletin boards disseminating news, presentation of new guidelines for curriculum, and presentation of broad school issues will be incorporated into the network's potential. Teachers and students will eventually be able to work with their counterparts in other schools. Evaluating the success of the project to date, a leader commented: "The level of interaction among thee kids is amazing. . . . Networking is vital. Schools simply cannot continue to function without sharing their resources" (Eichner, 1984, p. 1).

Excerpts from Education Daily (1984) characterized, with some humor, a mixture of ideas about the nature of the states' recent involvement and the priorities states choose to address:

> In many states, officials say, the tradition of local autonomy hinders the development of computer literacy tests. A recent survey of superintendents in North Carolina showed that while administrators agreed students should be computer literate, they opposed mandating a single set of standards. . . .
>
> The development of standards is also hampered by the fact that educators don't always agree on what constitutes computer literacy. . .

> We often don't know what particular proficiencies we are talking about. . . . (p. 2)

A top priority for 1986 from the federal level was recently reported by Manual Justiz, former director of the National Institute for Education. Funding is to be allocated for research and development efforts for instructional technology and school improvement (Report on Education Research, 1985).

In addition to formal research studies on school implementation and documentation from state and federal reports, a vital source of informational data on the integration of microcomputers in schools comes from the schools themselves, oftimes recorded in professional journals or shared through presentations at conference sites. A few examples are included here.

* Rosemount High School (Wilson, 1984). "Just about everyone at Rosemount High School in Minnesota has been using computers daily for a decade," Rosemount's principal reported. Visitors from many states, Canada, and Europe have learned about the educational potential of microcomputers from their observations at Rosemount, he noted.

* Palo Alto, California (School Tech News, 1984). Eight-hundred-student Jordan Middle School boasts a student tutor program that, without disturbing the regular school curriculum, manages to guarantee that its eighth graders are proficient in fundamental computer programming skills and that 25% will be competent with Word Star, word processing, and/or Multiplan, a spreadsheet database program. The principal has offered to share the plan for the student tutor program with other schools.

* Cupertino Union District (1983). Staff members wrote a K-8 computer literacy program in 1981, revising it in 1982. The plan involves all students with the computer as part of the regular curriculum. Individual and ample use times are provided. The comprehensive objectives are met through including them in instruction with content courses. The creators emphasized that "we still do not truly know about students' limits at each grade level on computers." According to the principal, another school adopting this model "must assess the strength of its staff, the configuration of the computers' locations and the priority of their usage."

* Case studies of four school districts that have successfully introduced computers into their educational programs (Lindelow, 1982) offer a variety of examples for school implementation processes. For example, Houston Independent School District established a department of technology. The district contracted with software publishers to provide computer materials to fit the Houston curriculum.

* In Jefferson County, Kentucky, with a grant from the Humana Corporation and a school board plan to raise $4.5 million, 85 elementary schools will be equipped with computers. An administrator praised the machines as student motivators. Teachers have been encouraged to be creative in incorporating computers into their instructional plan.

Finally, another means of identifying schools' integration of computers is to identify their uses within the curriculum content areas. Both researchers and school personnel have contributed to this knowledge base.

One example is the "Writing to Read" program (Wallace, 1984) adopted by the Portland, Oregon, Public Schools in 1983. It tests the theory that children will learn to read by first learning to write. All primary students become writers using the word processor. One student typed: "I liket the tipe riter Best of all and I like to work with you And I liket lisoning to the story's But best I like working with you."

The magnitude of written reports related to various applications of computers in the K-12 curriculum is impressive. During the course of the present study, three data-base searches of three different data bases located between 10,000 and 11,000 topical items.

Many educators believe that the instructional and school administrative uses of computers are closely intertwined. Caldwell (1984), for instance, described how computers assist administrators and teachers with routine record keeping, ultimately unleashing more instructional time. Students' learning deficiencies are frequently monitored by means of computer-managed instruction. Teachers may quickly prescribe appropriate help for individual students.

In spite of the mixed responses to the presence and place of microcomputers in public schools, their numbers and uses are growing. Evidence of the determination of individuals and groups to implement instructional computing in public schools grows as educators form computer using groups, attend a growing number of local and national computing conferences, subscribe to a number of electronic education journals, enroll in community education and college computing classes, sponsor summer computer camps for youngsters, and campaign for computers and software for their local schools. A new group presently forming professional liaisons is education computing consultants. Also, many states and teachers are working for certification of computing teachers. In the past five years, 115 computing periodicals have initiated publication (Lindelow, 1984a).

Numerous professional organizations, such as the International Reading Association (1985), have published guidelines for schools to follow when integrating computers into school settings. Becker (1982) pinpointed the challenge:

> We must think clearly about how we want our children's education to improve, what computers can do to help, how that assistance can, in fact, be accomplished, and whether any of this is affordable. Through appropriate research, well-organized strategies of educational program development, and careful policy-making and staff development by school systems, we may be able to make today's dreams about computers and kids into tomorrow's realities.

A Discussion of Selected Topics Related to Microcomputers and Student Learning

Computers or some form of computing activity is present in most Americans' daily lives. In fact, John Diebold, in an interview on public television's Late Night America, December 13, 1984, estimated that there are 20 million "computer literate" adults in the United States. A presence of sustained interest in microcomputer education (Wright, Melemed, & Farris, 1984) and reports such as that of the Task Force on Education for Economic Growth (Hunt, 1983) have generated demands that schools upgrade students' knowledge base and prepare today's pupils for future creative uses of technology.

Despite these pressures and realities, there is an ambivalence among educators, researchers, and futurists as to not only what constitutes a microcomputer education, but what true values the microcomputer ultimately holds for student learning or the enhancement of learning (Brophy & Hannon, 1984). Tashner (1984) surmised, "There are as many variations of computer literacy as there are people attempting to define it. The understandable result is one of confusion for educators who must make curricular decisions involving computers and children" (p. 1).

Some experts predict that the computer will soon be so absorbed in individuals' daily lives that what appeared initially as essential for teachers and students to learn will "self-destruct." Educators, for the most part, currently are acting to assure that students' skills and understandings of technology will not be taken for granted. Many local schools and districts have made a visible commitment and have at least begun the process of providing educational computing opportunities for students. To date, the schools' agendas on this matter have varied according to each school's interest, understanding, funding capability, and commitment (Becker, 1984; Market Data Retrieval, 1984).

Some Current Educational Uses of Microcomputers in Schools

This subsection presents discussions of the current educational uses of (a) examples of student learning-related computer activities and (b) specialized uses of microcomputers in instruction, including the learning disabled, writing/composition, mathematics, as tools for exploration, and for economically disadvantaged or minority students.

The Fast Response Survey System (Wright et al., 1984) reported that in 1982 the two chief purposes of school computers were for compensatory/remedial education, for basic academic skills or for learning enrichment when used as a tool, and, when viewed as an object of instruction, for teaching computer literacy or programming. Elementary and junior high schools more frequently listed computer literacy as a major instructional use. Programming was common in high school. Elementary schools used computers more for teaching traditional subjects.

It is misleading to report 1981-82 school-year statistics for the rapidly changing field of educational computing, but it provides a benchmark at a time when there is an annual doubling, even tripling of numbers of computers at school sites (Market Data Retrieval, 1984). At present, computer usage, even among schools having computers, varies (Wright et al., 1984). For example, about 10% of the schools used their computers only 17 minutes per day, whereas 13% of the schools in 1981-82 used their computers five hours per day. Elementary students were more likely to receive some exposure to computers than were students attending senior high schools that offered computer-based instruction, even though more high schools provided computer-based instruction.

Papert (1980) said that the computer's value lies not so much at the skill level of learning about its functions and then operating it, but with its interactive capability of opening up problems for solving and creating a window for exploration of microworlds. His years of experimental work at Massachusetts Institute of Technology with young children and the programming language LOGO focused on the child programming the computer. "And in teaching the computer how to think, children embark on an exploration about how they themselves think" (p. 19).

Pea (1983), in studying the prospects of the transfer of learning, problem solving, and programming with LOGO, cautioned:

> While we believe that . . . it would be premature to discard programming or LOGO from the set of microcomputer uses in schools, these studies do raise serious doubts about the sweeping claims made for the cognitive benefits of learning to program, particularly in LOGO. (pp. 30-31)

Research and practice, based on educational computer applications, are in constant debate about the issue of student learning. Shavelson and Salomon (1985) discussed the framework of educational computing by emphasizing the need to think beyond just the cognitive concerns and confront the "equally important issues"--philosophical, historical, sociological, economic, technical, curricular, and pedagogical:

> The impact of the new technology on cognition is not guaranteed. Its impact depends largely on how students and teachers use [it]. Whether [its] effects . . . are profound depends on learners' motivations, expectations, attributions, self-perceptions, . . . which, in turn, affect the extent to which computers are "mindfully" or "mindlessly" engaged. (p. 4)

They cited a "mindless use of LOGO" as a child's engagement in trial-and-error programming activities. Such use does not produce a mental set where powerful ideals will form.

As children use computers more frequently, they will encounter a demand for a greater degree of "explicitness in language than that involved in ordinary conversational language. Computers never understand ambiguous utterances . . . and never read between the lines" (Olson, 1985, p. 7). Olson perceived that to be intelligent in a computer-using society, one will need to be skilled in making meanings explicit.

Calfee (1985), in contrasting and comparing computer literacy and book literacy, urged educators to reconsider the goals of instruction in reading and writing and to incorporate the computer into thinking about a student's acquisition of literacy. "It is likely that in a decade or two, literacy will no longer imply 'book literate'" (p. 8). Children, he believed, have a unique learning experience, even as they initially confront a machine and a software package. Teachers, as they join with students in problem solving, play a role as a model for these interactions in modern life, and in being communicators and interpreters of situations fraught with uncertainty.

Exemplary teaching with computers also moves students further along a chain of events involved in problem solving using computers and programming than does "typical" teaching, according to Linn (1985), whose recent work is on the cognitive consequences of programming instruction in classrooms. She found that with appropriate instruction and computer access, many students can solve computer-programming problems, and some may gain generalizable problem-solving skills from introductory programming courses.

In a recent work, Patterson and Smith (1985) studied the role of computers in teaching higher order thinking. They perceived barriers inside of the classroom and curriculum that will, at least for the next two decades, stifle the promising potential they have documented in using computers to teach higher order thinking. They acknowledged that most schools do not presently emphasize higher order thinking, but they believed that microcomputers can help do this. A computer's "capacity to hold the attention of students for long periods of time and to engage them with complex problems is well documented. And, computer software in this area is improving rapidly" (p. 34). They suggested this definition of higher order thinking: "[It] occurs when a person is engaged in active and sustained cognitive effort directed at solving a complex problem and when the person makes effective use of prior knowledge and experience in addressing the problem." It must be a complex problem.

The uses of computers, which are not commonplace as yet in classrooms, according to Lesgold and Reif (1983),

> with proper design of the unit, can allow students to formulate hypotheses, test them, analyze results and refine their conceptions. Moreover, they can provide the student with a record of the course of his or her investigations, permitting greater self-awareness of thinking and learning. (p. 21)

At the present time, student-related microcomputer education in schools may involve any or all of the following elements categorized as skills or applications: computer-aided instruction (CAI), including drill and practice, simulations, and tutorials; programming or using the languages of computing such as LOGO, Pascal, and BASIC; algorithms, that is, step-by-step procedures related to problem solving; computer applications, such as word processing, data-base management, and spread-sheet analysis; learning about the machine itself; and gaining understandings of the computer and technology's effect on the social future, especially pertaining to ethical usages.

Tashner (in ERS Bulletin, 1984) identified seven major components of computer literacy programs in schools and emphasized that all seven remain sources of debate: (a) teaching about the machine, (b) teaching about programming, (c) teaching about algorithms and procedures, (d) computer-assisted instruction, (e) computer applications, (f) computer ethics, and (g) impact of computers on our current society and the near future.

Becker (1982) listed six major instruction-related uses of computers:

1. Drill and Practice: using computers for student practice of skills whose principles are taught by teachers in traditional ways.

2. Tutorial Dialog: Using computers to present information to students, diagnose student misunderstandings, and provide remedial instructive communication and individually-designed practice.

3. Management of Instruction (tied either to computer-based drill-and-practice or to a separate scoring system; or independent of either one): Using computers to provide the teacher with reports of individual student performance and to suggest appropriate learning tasks for individual students.

4. Simulation and Model Building: Using computer programs to demonstrate the consequences of a system of assumptions, or the consequences of varying an assumption, usually in conjunction with instruction in science or social studies.

5. Teaching Computer-Related Information Skills: Using the computer to teach students and have them apply such skills as typing, editing text, and retrieving information from computer systems.

6. Teaching Computer Programming: Having students learn to program computers as part of their instruction in mathematics or simply for the understanding of programming itself. (p. 15)

Hofmeister (1984) stressed the instructional applications of computers and discussed them in three areas: (a) computer-assisted instruction (CAI), which puts the learner in direct contact with the computer; (b) computer-managed instruction (CMI), which concerns the diagnosis of pupil strengths and needs and prescriptive instructional interventions; and (c) computer literacy, which entails the learners becoming aware of the applications of computers in society, acquiring technical operational skills related to the computer as a machine, and acquiring knowledge of the computer's logical process and formal programming languages.

The Montana Office of Public Instruction (1983) prepared for constituencies a list of how computers can be used in schools: for integration into curriculum areas; problem solving; tutoring; drill and practice; teaching computer literacy--that is, to teach about computers, how they are used in everyday life, the responsible use of computers, and so on; instructional games; simulations; hand-eye coordination; teaching computer programming; word processing; administrative applications; counseling and career information; managing instruction; library usage; teacher/student research; and students with special needs.

White (1983) reported that "much of what we know about electronic learning--learning via electronic sources--is anecdotal and word of mouth" (p. 13). Because the field is new, she cautioned that many of the "so-called" findings may not hold up over time.

Kulick (1983), in a synthesis of research, verified that computer-based instruction (CBI) has progressed in the last 20 years.

> Pioneers in CBI believed from the start that the computer would bring students great benefits such as better, more comfortable, and faster learning; opportunities to work with vastly richer materials and more sophisticated problems; personalized tutoring; automatic measurement of progress; and more time for meaningful contact with learners. (p. 19)

How educational computing was integrated and implemented (or, in some cases, not) into a school's curriculum (Cory, 1984; Natkin, 1984; Skinner, 1982); teachers' attitudes about using computer and how they were prepared to teach with and about them (Peterson, 1984; Wimmer, 1983); how students learn with and from computing (Kulick, 1984; Papert, 1980; Webb, 1984; White, 1984); what uses were deemed essential for students (Becker, 1982; Bork, 1984b; Cupertino, 1983; Luehrmann, 1984; Moursund, 1984b); and which students have access and use (Shavelson et al., 1984; The Computing Teacher, 1984) become no less important but much less clear as the diverse menu of educational uses and potentials of microcomputers are investigated, verified, and oftimes nullified by researchers and practitioners alike.

Pepe (Market Data Retrieval, 1984) referred to the present ambivalence about what constitutes a justifiable computing curriculum at public school sites. "There is a genuine belief that the computer is a powerful tool that will increase the productivity of either learning or teaching. This is probably the most important reason for a school to purchase a computer and, yet, it is the one that is most speculative" (p. 1).

Walker (1983) stated that communities, schools, and teachers must embrace computer education, in spite of the fact that

> enormous practical, pedagogical, and technical problems must be solved. . . . Success in using microcomputers for education will not solve the serious educational problems schools face, but failure will leave the schools even more poorly equipped to cope with them.

While early experiments and efforts with computer-assisted instruction (CAI) did not have the promising outcomes for students that many early computing teachers anticipated (Shoen & Hunt, 1977), more recent developments in technology and the continuing improvement of instructional software, from the early mere replication of print onto disk, have encouraged a cadre of trained and committed educators to move away from instructing students in beginning awareness and literacy, and toward the application of computers into all possible curriculum areas and aspects of learning (Minnesota Association of Supervision and Curriculum Development, 1982; Moursund, 1984a, 1984b; Powell, 1984).

Descriptions of Selected Examples of Student Learning With Microcomputers

Numerous and diverse studies conducted in laboratory and school settings, surveys, case studies, dissertations, and local school and district anecdotal reports help describe findings about the relationship of microcomputing to student learning.

Because of the recency of educational computing in public schools, few researchers or reporters have ventured conclusive statements or generalizations about student learning and microcomputers. Specific aspects of electronic learning have provided interesting findings but usually recommend further research. For example, Griswold's (1984) study of elementary students' attitudes during two years of computer-assisted instruction found significant improvement in students' self-confidence, which could over time be positively related to individual student achievement.

An Educational Technology Center was recently announced by the Educational Testing Service (ETS Developments, 1984). Funded by the National Institute of Education and located at the Harvard Graduate School of Education, a consortium will examine ways to employ technology to increase the achievement of students in elementary and secondary schools. "Through the national dissemination effort, the Center hopes to eliminate much of the mystique that now surrounds the use of technology in the classroom" (p. 8).

Becker (1984a) surveyed 1,600 microcomputer-owning public and nonpublic secondary and elementary schools and reported data on school uses of microcomputers in 1,082 schools during the 1982-83 school year. The results of that study were in press during spring 1984. In the same time frame, Becker intends to initiate a new study that will "provide more up-to-date descriptive information and more detailed data about curriculum-specific environments in which computers are used in schools" (p. 9).

An example of the types of inquiries made by Becker include scheduling students at computers, wait time for use and activities conducted while computing and while waiting, and what outcomes were achieved during those times.

> With our survey data, we cannot measure whether grouping students at the computer is better or worse than having them work individually under the given circumstances. At best, we can examine whether teachers whose students work in pairs or groups believe that their students have more positive learning or attitudinal outcomes than do teachers whose students work by themselves. . . . What might be seen as an effective arrangement for one use of computers--say, teaching programming to high school students--might not be seen so positively for another use--e.g., drill-and-practice with elementary school students. Thus, the analysis must be limited to those schools where the one teacher's use is essentially synonymous with the school's use. . . .

Thirty-five junior high school students participated in a one-week LOGO programming workshop while Webb (1984) studied the implications for students of learning while working in groups of three. She concluded that learning computer programming can be accomplished successfully in group settings.

The Wisconsin Center for Educational Research (1984) has as one of its projects, one that investigates the stages of development in young children's mathematical problem-solving skills, so that software programs can be developed to reinforce and build on children's natural skills in problem solving.

Kulick, Bangert, and Williams (1983), in a meta-analysis of 51 research studies on the effects of computer-based instruction, cited, among others, the following: (a) that it can improve student learning, (b) that students' attitudes toward computers are more positive because of involvement with computer-based instruction, and (c) that various findings have shown a savings of from 39% to 88% on student learning time using computer-based instruction. The researchers explained that the rapid changes in technology and in the actual classroom uses of computers could alter their predictive value.

In summarizing the results of a year-long pilot project in six elementary and middle schools in Montgomery County, Maryland (Hunter et al., 1983), the researchers noted the following characteristics present in schools where both teachers and students made rapid strides in attaining computer literacy: (a) sufficient computer equipment, so that when scheduled carefully, most students had access; (b) sufficient and varied software; (c) a knowledgeable, resourceful media specialist; (d) planned and ongoing teacher training; (e) strong teacher collaboration and support from a computer coordinator; (f) administrative support and leadership; and (g) student enthusiasm. "The high interest of students in computer-related activities proved to be a major motivating force for teachers" (p. 118). Teachers discovered that students could help each other, were enthusiastic about the study of procedural thinking, and were resources of help and ideas for their instructors.

The researchers of the pilot project reported two negative factors, other than limitations caused by underfunding: (a) the complexity of integrating new tools and materials into existing traditional curricula: "Many of the skills that computers teach best are not included in the existing curriculum"; and (b) the inflexibility of the teachers' workday, for experimenting and innovating. The researchers recommended that factors which foster or impede facilitation of instructional computing be given attention by schools intending to initiate programs.

White (1983), director of the Electronic Learning Laboratory at Teachers College, Columbia University, where numerous research projects with student learning are underway, believes it is still too early in the innovation to extrapolate answers and that technology is changing too rapidly to get locked into a direction that cannot be altered to better advantage. Her present observations include:

1. Pupils do learn more quickly when they are exposed to computer-assisted instruction than in traditional classroom instruction.

2. Computers may be just as effective for certain types of learning as is the printed page for others.

3. No systematic studies indicate that computers motivate pupils, but observation indicates that children take to computers like "ducks to water."

4. Some of the characteristics which seem to be important to children in relation to computers are the idea of a challenge, the involvement of fantasy, and the game format. "A pilot study by the Electronic Learning Laboratory found that pupils involved with the computer ask more questions than they do in the traditional classroom."

5. Technology has been found to be attractive to children in contemporary society.

6. So far few studies are available to describe what kind of child might initially have the smoothest experience working with computer language. Early evidence suggests that children who are good in mathematics and science which are allied skills to programming will be successful computer users.

7. Computers, so far, have not isolated children from one another; in fact groups around a computer have tended to socialize their learning experience. That may change when children have their own computers.

8. Software is only in its infancy. So far, it is not very sophisticated. Print material, like text books, does not translate well into very good software. "At the moment, even bad software seems to be capable of teaching. The secret is the computer seems to keep children attending to the learning, and the practice really happens."

9. Nobody knows yet what computer technology can really do. "The technology will make different demands on the learner. Children will rely more on imagery comprehension than on word comprehension."

10. Nobody knows what the newer technology such as teletext, videotext and videodisc will be.

Finally, White concluded:

> What the new technology can do and what form it will take is anyone's guess at this point, but we do know that it is exciting, it is happening and it is going to change. Schools will never be the same again. (p. 15)

Sheingold et al. (1983), working with the Bank Street College of Education, used the case-study method to increase understanding of the effect of a technological innovation on children and teachers in the classrooms and three demographically diverse school sites. Student learning with computers was affected at all levels of implementation and use by the individual's interaction with the computer in the social system that surrounded it. The authors also found that:

1. The principal is a major source of support for teacher preparation.

2. No one yet really knows the "educational or developmental consequences of using microcomputers."

3. Student outcomes reported by teachers are social, relating to student interaction, status, and self-esteem, and with few exceptions, such as with the learning-disabled students, there were no "specific expectations about what children would or should learn."

4. The fact that "no one knew what children were learning by interacting with microcomputers targets this as high priority for research" (p. 430).

Sheingold et al. commented: "The cases examined here, however, suggest that microcomputers on their own are unlikely to promote any particular outcomes" (p. 431).

A multiyear study that identified concepts, issues, and set parameters for educational computing in schools drew input from national computer experts. The assessment questions formulated as guidelines for school self-assessment indicated in large measure that it is important for students to know and do with computing (Lockheed et al., 1983).

Becker (1984b), in reviewing present practices in public schools, was disheartened by the overuse of drill and practice.

> Rather than helping students expand their intellects, [it] conditions them to regard the computer as a rather boring tool of the teacher over which they have little control. . . . Where is the . . . instruction that deals with thinking and understanding? (p. 31)

Specialized Uses of Microcomputers in Instruction: Selected Examples

Microcomputers and the learning disabled. The computer can, according to Weir, Russel, and Valente (1982) make equal opportunities possible for the learning disabled child.

> The computer is flexible and permits and teacher to design a plan unique to the learning needs of a special student, whether the child is physically disabled and needs reinforcement with concepts such as motion and space; or the child cannot speak or is hearing impaired, with the computer has the facility of communication. (p. 346)

LOGO, for example, is a powerful language, through which, with the teacher's assistance, an autistic child can build bridges to "self-initiated and self-driven activities" (p. 347). A physically handicapped child may have his/her first opportunity to respond to feedback or initiate solutions.

> A major problem for severely disabled individuals with little motor control is that of being totally dependent on other people to produce a written record of their or other people's thoughts. . . . The unleashing of trapped intelligence can be quite dramatic. (p. 347)

Computers and writing instruction. In this section only a sampling of numerous possible computing applications is discussed in relation to student learning. Beyond the knowledge needed to operate the system, some keyboarding expertise, and the intellectual skills to produce coherent thought, the student can be aided by a computer in tackling writing assignments and improving expression. A text can be changed and revised rapidly without laborious manual redrafting. Workman (1983) said that writing is "coaxing what one means to the surface through writing words on paper" (p. 203). Word processing has become the most popular home and business use of the computer, one of the chief reasons being the ease with which one can change copy.

Rubin and Bruce (1983) named six ways in which computers help students write more successfully: (a) planning before writing, (b) the integration of reading and writing, (c) writing for a real audience, (d) two-way written communication, (e) cooperative writing efforts, and (f) understanding that revision is part of production.

Becker (1984b) reminded educators to keep in mind the cost and relative efficiency of computer-based writing as compared to less technologically sophisticated means. Under optimum conditions, he perceived computer-based writing as:

> a possible means of enabling students to express better the vague thoughts and feelings that abound inside each of them and to translate their ideas into a publicly visible, defensible, intellectual product . . . a means for students to become literate, but to use literacy to make a productive contribution. (p. 37)

Microcomputers and mathematics instruction. Selected examples of positive achievement effects for students having guided mathematics instruction with computers were recorded in a 1978 study of fifth and sixth graders in West Lafayette, Indiana. They increased their interest in mathematics and their abilities to problem solve. An additional study, conducted by Berger, University of Michigan, resulted in an increase in elementary and junior high school students' achievement with estimation skills, regardless of the students' initial ability levels (Action Research, 1981).

Wisconsin eighth-grade students solving mathematics problems with the use of the microcomputer outperformed both students without computers and those using only flowcharts (Foster, 1983).

Burns and Bozeman (1981) used meta analyses to integrate findings of computer-based instruction in mathematics teaching in elementary and secondary schools and found computer-based tutorials raised achievement test results by .45 standard deviations and that computer-based drill and practice raised test scores by .34 standard deviations.

The National Council of Supervisors of Mathematics (1978) listed ten "interrelated" skill areas "basic to development of pupils' ability to reason effectively in varied situations." Educational computing was one of the essential skill areas noted.

Microcomputers as tools for exploration for all learners as well as for intellectually gifted learners. It has been repeated through various sections of the present study that oftimes the problem-solving and interactive uses of computers may promise the highest potential for a valuable contribution to student learning, but for various technical and managerial reasons have gained little application across school sites. When computers have been used in these more sophisticated realms, the usage reported frequently occurs among classes or opportunities for the gifted and talented (Shavelson et al., 1984). The drill and practice structured lessons have commonly been those received by low-achieving students.

The present study is not designed to single out which computer applications have most relevance for learning. The emphasis in the few examples offered is to present the magnitude of the potential. It is important as the knowledge base grows for educators to attend to the equitable delivery of the best applications to the most students possible (Lezotte, 1984b).

Limiting the potential of the computer and the groups who have access may obviate the opportunity for enhancement of students' intellectual experiences, according to Leonard (1984).

> Strange as it might seem, it would be entirely possible to put millions of computers in the schools without producing any real change in education. Computers could be cordoned off in a separate department. . . . Students would go [there] to learn how to use computers, but the rest of the school would remain just as it is. (p. 51)

Some computer educators do emphasize that the exploratory attributes available in future computer software may enhance the learning and attitudes of all students. Discussion around the topics was reported by Jorde and Ford (1985), Ferrell (1985), Griswold (1984), and Gourgey (1985).

Koetke (1984), for example, explained that the computer is not like the automobile or the microwave oven; it is interactive, a capability that can expand the intellect. He believed that both teachers and students should be programmers.

Leonard (1984) commented that "education of the purely rational faculties is only half an education" (p. 56). The idea that the computer can store and retrieve vast amounts of important data and manipulate complex, multitiered problems that would take an individual hours or days to execute was described by Bork (1984a), Leonard (1984), and Koetke (1984).

Powell (1984) summarized the frame-shift model that he and his colleagues currently apply to classroom models where students have opportunities to explore and interact with computers using lateral thinking or frame shifting.

> Computers . . . are windows upon the aggregate knowledge base of mankind, once we have learned how to use them this way. . . . The fact that we can have computers store and perform data transforms enables us to preserve and tap the intelligence of others (and ourselves). (p. 21)

This capability enables students to move rapidly up the hierarchy of abstraction without performing every transform procedure along the way. Thinking divergently and having time to suspend making judgments lets students evaluate constructively. Powell also observed students using this model as they are actively and constructively engaged in learning, calling it a "rewarding experience" for a broad segment of the student population.

Microcomputer instruction for the low-income or minority student. While most reports of low-income, minority student interactions with microcomputers are linked to upgrading essential skills with drill and practice, one project provided students in this socioeconomic category with a home computer for multiple usage. The Study of Interactive Technologies in Education (SITE) at New York University provided 24 students with a home computer and 22 other students with a computer only during the school day (Ely, 1984). Positive changes were reported for the home-computer-using students in the following areas:

1. Those with computers to take home had appreciably better attendance records during the program.

2. Students became teachers of others at home, of relatives, and of neighbors.

3. The students, ages 7 to 14, evidenced an expansion and enrichment of their language and an improved attitude toward learning, including enhanced self-esteem.

4. Both parents and students voiced an increased hope for the children's future life.

5. Their overall educational skills improved.

Helen Kelly, director of the study, advised educators to "make meaningful progress towards computer equity; educational institutions must take a leadership role in helping children and families to utilize this new technology as a major learning tool."

Policy Considerations Confronted by Educational Planners Formulating Educational Computing Programs

This portion of the literature review focuses on the subjects of policy and change, in and of themselves, and presents a few important policy and practice issues relevant to the integration and implementation of K-12 instructional computing programs currently in process. Discussion includes policy considerations related to (a) educational usages, (b) student access, (c) educational equity, (d) staff training and technological updating, (e) instructional software, (f) instructional hardware and peripherals, and (g) funding and focus issues.

American society generally expects two provisions from its public schools: (a) that students will have access to education and (b) that the education provided will be of a quality and content similar to that offered to all other children (Brookover & Lezotte, 1981). In the United States the history of public education records a series of calls for reform (Passow, 1984). When society encounters a dramatic shift historically, the American public expects its schools to respond. It has been frequently stated that schools mirror society (Natkin, 1984).

The current wave of reform reports and mandates indicates a rising tide of public pressure on the educational system to improve schools and the academic achievement of today's students and to provide a technologically relevant curriculum. A swirl of issues is immediately raised once public schools commit to any change.

Evans (1981) admonished: "There is no halfway house, and never has been. Once the first step has been taken, all others must follow unless we are to return with the insects to dust" (p. 293).

Walker (1983), a self-admitted "veteran" of educational revolution, predicted that the spotlight on computers-in-education will shift in time and suggested that educators ponder both the attributes and limitations of computers by asking, "What can students learn or teachers teach using computers that they could not do, or could do only with difficulty, otherwise?" Computers, he commented, are (a) a supplement, not a substitute for traditional education; (b) difficult to use, and teachers are few who are prepared to use them; (c) changing rapidly and there is little standardization; (d) lacking sufficient or appropriate and quality software; and (e) so recent an innovation that "we are only beginning to understand [them] in education. Microcomputers will not solve (and may aggravate) several of the most serious current problems confronting education--notably equity, school finance, and divergent public expectations" (emphasis added) (p. 119).

Howe (1983) spoke of the "major gaps and unattended issues" raised by national reform groups. Educators are experiencing both an "exhilarating and intimidating" climate. He urged planners to study the more serious, scholarly research before "doing something." Political leaders who formulate many policies that affect local schools work within two- to four-year intervals; local schools, historically, must change over longer periods of time.

Gray (1984) reported that "microcomputer technology . . . is part of curriculum mandates in virtually every state" (p. 72). But eventually a policy response to instructional technology will evolve from each of the over 16,000 local school districts (Lezotte & Bancroft, 1984).

Holloway and McDonald (1981) urged a "controlled consideration of the growth and implementation of microcomputers" (p. 2). They defined policy as the "means by which a governing body formulates and states its intentions" (p. 5) and recommended policy development as a first response.

In addition to developing a philosophical and financial commitment to instructional computing, Rockman and Rampy (1983) found typical school district administrators and boards to be currently concerned with (a) curriculum impact, (b) courseware development and evaluation, (c) teacher training, and (d) equity. An overarching consideration for policymakers is change itself, especially in a time of rapidly transforming technologies (Grant, 1983; Guertin, 1983; Hall et al., 1975).

Policy analysis, according to Gray (1984), helps planners focus on problems, issues and needs.

> Policy analysis is a vehicle by which district administrators can gain knowledge for decision making relative to an innovation like computer use. Through policy analysis they can come to understand the problems-issues-needs surrounding computer use in their own districts. As a result, they can be in a position to set the direction and content of such a change. (p. 76)

"More important for change in practice," Fullan (1982) noted, "is implementation-level participation in which decisions are made about what does work and what does not" (p. 65). Dollar (1983) took issue with reformers: "They miss the center of the target, which is the dysfunctional structure of the school itself" (p. 8). He spoke of three necessary ingredients necessary for school change: creative resources, community support, and leadership.

A Los Angeles County computer consultant said:

> Schools are facing a new way to work . . . a new way to learn [and] a new personal tool. . . . More changes will keep coming. . . . We face not a cosmetic but a structural change . . . if schools do not rise to this occasion, other institutions will. (Guertin, 1983, p. 30)

Koetke (1984) warned that "schools have only two or three years left in which they will be able to again grasp the reins of educational leadership, and that can only be done by making rapid changes in an institution traditionally slow to respond" (p. 169).

Educational Uses as a Policy Consideration

When a school begins to provide microcomputers for educational purposes, local educators must have answered this question to their satisfaction: "How will computers enhance and maximize student learning?"

> Little is known about who are using the computers and for what purposes they are being used. . . . Recent surveys indicate the primary uses . . . are for programming in BASIC, general 'computer awareness courses' and for drill-and-practice applications. . . . Little cumulative knowledge has been obtained. (Lockheed et al., 1983, p. 3)

Educators could be easily confused, for, according to a recent report, "there is no typical way schools use computers because the technology is so new and has been introduced into the schools in a disorganized fashion" (Report on Education Research, 1985, p. 8).

Luehrmann (1984) outlined timelines and strategies that could be used by districts to assure, as much as possible, that students attain a degree of computer literacy. He did not include a bits-and-pieces approach over the course of 13 school years, but called for a "beachhead" approach, and believed his plan would be workable within the time, staff, and financial constraints extant in school districts across the nation:

> We are asking too much of our schools today in expecting them to integrate the computer immediately into their traditional curriculum. We must never forget that that is the ultimate goal of teaching computer literacy--to give students computer skills they can use in all of their traditional subjects. But we must also not

> lose sight of the practical constraints that make that goal a long term project . . . and not one that can be accomplished overnight. (p. 40)

Moursund (1984a) urged educators to perceive computers as an "aid to accomplishing the underlying purpose of each of the basics." For example, "'writing' will include keyboarding and the use of a word processor. . . . 'Arithmetic' will include making use of calculators and computers as aids to problem solving" (pp. 4-5).

Actually, student usage has changed from the beginning days of microcomputers in school, and before when terminals were wired to mainframe computers. The thrust in the early days was a goal of student "literacy," which loosely defined is a student awareness of and acquaintance with computers, perhaps a programming course elective in the eighth grade, and some computing in business, mathematics, or computer science classes at the high school (Miller, 1982).

Emphasis will be changing as technology changes, computer experts believe. Present computer usages embrace a broad array of student understandings and applications at appropriate times and in appropriate content areas and, importantly, presented by well-trained and enthusiastic teachers (Moursund, 1984f). Yet Moursund (1984a) asked, "Where is the change? Has the geometry course changed? How about science labs?" (p. 185). While he found some schools with adequate computers to support broad curriculum changes, he discovered that even those schools retained a more or less traditional curriculum.

Moursund cited those computer-related changes that have already occurred and are in place in most schools:

1. Large numbers of students now take computer literacy, programming, or computer science, even in elementary school.

2. "Some computer use has been integrated into some parts of the school curriculum."

3. Computers are forcing a reexamination of the curriculum.

In Becker's (1984a) study of school uses of microcomputers, the major elementary school uses were: introduction to computers (64%); drill and practice (59%); programming (47%); tutoring for special students (41%); programming to solve problems (27%); recreational games (24%); demonstrations, labs, simulations (20%); administrative usage (10%); and student word processing (3%).

The South Dakota Department of Public Instruction (1984) asked state schools, "Which curriculum areas utilize computers?" Ninety-seven percent of the K-12 schools reported their most common usages to be computer literacy, computer programming, mathematics, reading, science, and language arts, with computer literacy dominating the elementary results, and computer programming, the secondary report. Mathematics was a noticeably used component across most elementary, junior high, and senior high schools.

Allen (1984) reminded educational policy makers that updating training to be in tune with changes will be essential and will need to continue beyond grade 12. Goldberg (1984) encouraged business and industry to share the responsibility for setting a curriculum agenda and funding it. But Giroux (1984) cautioned, "We must criticize the movement to link outcomes of education solely to needs of the business community--a philosophy that undermines efforts to equip students with the skills necessary to analyze the sophisticated processes at work" (p. 6).

Bork (1984b) provided sketches of the best and the worst scenarios of curricular uses of computers and stated, "Most learning is still taking place through the passive learning modes that have been dominant for hundreds of years: books and lectures" (p. 242).

Shavelson et al. (1984) gave examples of the daily uses of microcomputers by various teachers, categorizing them as "orchestration," "enrichment," "adjunct-instruction," and "drill and practice." The researchers concluded:

> Simple logistical procedures need to be considered, such as rules for student use, transitions between computer and non-computer activities, and grouping strategies . . . and more importantly . . . matching the computer and available courseware to their instructional goals, the structure of the subject matter, the nature of the students, and the content of instruction. (p. 97)

Finally, policymakers need to consider educational usage of microcomputers in relation to equity. Shavelson et al. (1984) reported findings concurring with those of Becker (1983), The Computing Teacher, (1984), Reisner (1983), and Walker (1983): "Microcomputer-based instruction might systematically differ as a function of income level, and minority and ability status" (p. 62). They observed:

> Specifically, classrooms with students above average in ability and low in number of minorities tended to be found with teachers characterized as "orchestrating" the ongoing curriculum with a wide variety of microcomputer-based instructional modes stressing both skill acquisition and conceptual knowledge. As the ability level decreased and percent minority increased . . . the instruction tended toward "enrichment" or "adjunct instruction."

They further surmised:

> The five classrooms with a high percentage of minority students, low in ability, employed microcomputers to deliver drill and practice on basic skills taught in class. If the medium is the message, the message delivered to students of "drill and practice" teachers is substantially different from the message received by students of "orchestrators." (p. xii)

Goldberg (1984) urged that "we position ourselves as effective users of the information machines: to develop information and not just program on them" (p. 284).

Student Access as a Policy Consideration

School policy makers have been reminded to attend to the access arrangements made for students to achieve the instructional uses specified by the school. Brookover and Lezotte (1981) suggested that current federal policies and programs cite three standards that determined whether local-level educational programs were advancing educational equity: access, participation or use, and outcomes. They asserted that all three must be present.

Lezotte (1984) stated that many facilities, kinds of equipment, services, and choices (whether caused by policy decisions or lack of policies) are inaccessible to some students:

> Access to computers and computing instruction is limited for many students. The levels of access to new technologies commonly vary from building to building within a given school system. School people might explain that one school has different priorities from another. Whatever the reason offered, the fact remains that some students, usually the most underserved by the schools--have been denied access to some valued service. (p. 4)

It has been not uncommon for schools to have a policy, written or unwritten, or perhaps caused by a limited number of computers, which extends computer uses and access to selected individuals or groups. Student access to computers is closely related to where computers are placed, how they are scheduled, how staff supervise and provide for access, and how staff are trained to help students. For example, if only one or two computers are available in a given school, or if only a few teachers are computer proficient and available to assist students at certain times, then equitable access to all students is virtually impossible.

Access is also influenced by funding. Without federal, state, or external supplementary funding, many financially strapped local schools and districts have had to decide where to place their few computers for maximum use and effectiveness (Anderson, Welch, & Harris, 1984). At present, some available external funds designate student access to special-needs groups.

Educational Equity as a Policy Consideration

Becker (1982b), in his extensive study of school uses of micro-computers, found that within each school questions arose concerning *use*, *access*, and *distribution* of computers and instructional computing opportunities:

> Some schools tend to allow the brightest, most motivated students to use a limited number of computers. . . . Drill and practice uses may be channelled to the lower-achieving students. . . . Such divisions may exacerbate the variations in attained academic competencies between the initially slow and the initially high-achieving students. (p. 55)

Komoski (1984a) noted a variety of inequities in the provision of student instructional computing opportunities. Lautenberg (1984) described the differences in opportunity available to students in the same school district. "Children, living in one neighborhood, may attend a school where there is ample instruction, equipment, software and encouragement, while students in another neighborhood may have little or no such opportunity." Anderson et al. (1984) listed the size of community, the region one lives in, one's sex, and one's race as factors that have been reported as influencing a student's educational computing opportunities.

Elementary principals can help diminish computer anxiety and promote equity, according to Winkle and Malhuis (1982), by (a) enhancing the self-concept of girls concerning computer technology through structured activities that are success oriented, (b) promoting computer literacy as a survival skill, and (c) expanding career goals for girls to include technology.

The equity issue was perceived by Dollar (1984) and Lautenberg (1984) to extend beyond the fair distribution of instructional computing to all students regardless of inherent demographic differences. They saw equity as a societal problem, as well. Edmonds (1979) defined equity as the "simple sense of fairness in the distribution of the primary goods and services that characterize the social order" (p. 15). He questioned some prevalent interpretations of "the minimum level of goods and services to which all are entitled" (p. 15).

Koerner (1982) and Wilson (1982) reminded secondary administrators to help close the technological-skill gap for all students. According to Lautenberg (1984), "The uneven distribution of computers among schools raises concerns that a new form of segregation is developing, separating those who are familiar with and competent to deal with the new technology and those who are not" (p. 13).

Staff Training and Technological Updating as a Policy Consideration

Bork (1984a) believed that, generally, "United States' teachers are poorly trained to use computers effectively" (p. 179). Teachers, district-trained in computer uses through occasional inservices, gain little lasting understanding of educational applications, he reported. And, as for preservice teacher education, he said, "Training about computers offered by many schools of education is worse than no training at all. A few rare exceptions offer excellent training."

Shotwell (1983) believed the most important component in implementing a computing program in K-12 education is the training of the instructional staff. A district that has new computers and lots of software, but no trained staff, is like an airline with a hundred brand-new 767 jet airliners and no pilots," according to Helen Ditzler (1983, p. 101), who directs staff development for the Montana Office of Public Instruction.

May states have recommended or soon will, with varying stipulations, minimum competencies for educators, at least for the teaching of computer science (Education Daily, 1984). Important to the staff development and ongoing training of teachers is the principal's leadership. Local administrators need to be supportive of ongoing staff training and be involved in such training themselves. Mims and Poirot (1984) identified 35 desirable administrator competencies.

Lindelow (1984) wrote an entire book on administrative involvement with computers. Principals can be influential in helping teachers overcome computer phobia and instrumental in assuring the integration of computers into the curriculum.

Moursund (1983) pointed to a major implementation problem in schools as that of "training teachers so they have the knowledge, skills, and attitudes to effectively use computers with students" (p. 8). He suggested that principals might expedite staff development by (a) choosing an in-house expert who is enthusiastic about educational computing, (b) overseeing an individualized teacher-made plan for keeping up in the field and relating that to the teacher's instructional area, (c) encouraging and implementing additional training opportunities, (d) creating an awareness of courseware evaluation and locating sources to help teachers select proper courseware, and (e) making the most use of the equipment provided.

Results of a study by Shavelson et al. (1984) added significant information to what makes successful microcomputer-using teachers. The findings promise to enlighten training processes and help define the courseware that would enhance pedagogical aims.

Sheingold et al. (1983) were convinced of the importance and complexity of teacher involvement with microcomputer education. From the case studies, it appeared

> that such integration is likely to take place only if classroom teachers actively work toward it. . . . It may not be accidental that where microcomputers were located in elementary classrooms, there were also teacher buffs. (p. 428)

"What constitutes a well-qualified teacher?" asked Moursund (1984-85).

> Most of the necessary research remains to be done. I suspect that a major part of the answer will be the teacher. There is no substitute for a well-qualified, experienced teacher supported by appropriate technology. (p. 4)

Becker (1984b) found that inservice presentations were frequently on single issues, and because of time and resource limitations, only certain elements of instructional computing were included in local training programs.

Before beginning their six-school study of microcomputers in school settings, researchers provided teacher orientation for the teachers to be involved with student activity. Without such preliminary reinforcement with machine and software, Hunter et al. (1983) said that "teachers would have been less willing to try instructional computing in their own classroom" (p. 117).

When a technology is new, only a few, whom Hall (1982) called "early adopters," jump in to learn all there is to know about it. That group in educational computing were identified elsewhere in the study as those who brought their personal computers to school for students and sought their own learnings in a variety of settings. However, a large majority of educators learn about microcomputing when it is presented to them in inservice or preservice experience. Among this audience are those reluctant to embrace computing because of an aversion to the new or to change, lack of available support mechanisms and resources, or doubts about the efficacy of computers in K-12 education.

The Educational Technology Center (ETS Developments, 1984) has recently developed a research agenda focusing on "the use of technology for instruction. . . . The Center will have a tremendous impact on how technology is used in the classroom" (p. 8).

Much yet needs to be known about effective classroom use of computers and what teachers need to know and do to assure that computers are active, useful tools of learners. Numerous current dissertations have focused on these classroom interactions. Examples are Ferres, "Training and Implementation Strategies Appropriate to the Introduction of Logo Into Teachers' Curriculum (1983); Peterson, "The Effect of Individual Inservice Training on Teacher Use of an Innovative Technology, the Microcomputer" (1984); and Allen, "An Analysis of the Social Interactions Among a Teacher and Small Groups of Students Working With Microcomputers."

Dede (1983) envisioned a day when students would be "'trained' by computers and 'educated' by teachers, allowing both computer and teacher to function in more efficient and cost-effective ways" (p. 22). To expedite teacher responsiveness to instructional computing through preservice and inservice training activities, Lee (1983) prepared a series of skill demonstrations. Naiman (1982) provided a list of seven evaluative questions administrators might use to assess the success of a local computer education program. "One problem with trying to determine the success [within] a single classroom is that a great many factors that encourage teacher success are really due to a system-wide plan for computer use and support of it" (pp. 42-43).

Becker (1982) urged school systems "to seek to develop computer literacy in as many staff members as possible. . . . For many teachers computer literacy should also include acquiring the ability to write computer programs . . . and to teach programming" (p. 58).

It was apparent throughout the literature that a concurrent need for staff support and development occurs at any juncture where an innovation infiltrates a school or is formally adopted by a school system.

Instructional Software as a Policy Consideration

Improvements in the quality and quantity of appropriate educational software have only recently been reported (Moursund, 1984-85; Natkin, 1984). Natkin encouraged educators to be patient. "I think we'll see plenty of quality software before long" (p. 15).

Very few teachers have created software curricular components to supplement their teaching. Walker (1983) reported that "good programs are scarce . . . because creating them is difficult, time-consuming, and expensive." Educational Research Service (1983) reported, however, that with the growth of computer technology there has been an increase in the number of district-developed computer programs designed by teachers and students. This courseware addressed needs of particular classrooms or of the administration and also enhanced the expertise of its developers.

Starting at base zero, a little over a decade ago, production of specifically targeted K-12 educational courseware has been slow to develop because of the complexity of curricula and the diversity of student and teacher needs and abilities to be addressed. In addition, the home and business markets have captured the attention of major software developers. These and other related yet complex reasons have caused producers to be reluctant to make expensive investments, and school people to be cautious about purchasing software that is not only expensive, but also might prove to be educationally inappropriate or geared to a very limited audience. Thus, selection and evaluation of available software were and are major discussion points among educators.

The Minnesota Educational Computing Consortium (MECC) has devoted time and expertise to developing quality software for school uses within Minnesota. That software is used extensively nationally. Michigan REMC's, in fact, assist local schools in procuring it (Zolton, 1983).

Evaluation of software for curriculum-matched uses in classrooms is time-consuming but essential. Educators take advantage of MECC's efforts to provide and distribute such analyses. Education Week (1984) reported that districts in 30 states use the software-evaluation services of either MECC or MICROSIFT.

Komoski (1984a), reporting evaluations through the Educational Products Information Exchange (EPIE), noted that "only 5 percent of hundreds of [software] programs have been judged to be of truly high quality, while more than half have been judged not worth recommending to educators or parents."

Bork (1984b) listed the factors that characterize poorly designed educational software:

* failure to make use of the interactive capabilities of the computer;
* failure to make use of the capabilities of the computer to individualize instruction;
* use of weak forms of interaction, such as multiple choice;
* too-heavy reliance on text;
* too-heavy reliance on pictures, when they do not help learning;
* treatment of the computer screen as a book page;
* use of attractive or entertaining material which is only "vaguely" educational;
* presenting content that does not fit into the curriculum;
* presenting game focus without educational merit;
* use of long sets of instructions;
* heavy dependence on auxiliary print materials;
* presentation of content in segments without context;
* use of materials that fail to hold students' attention;

Many companies are concentrating more on distributing software than on developing it. Bork (1984b) declared that quality software is possible and must begin with a clear pedagogical purpose. "In the future, school officials . . . will buy certain brands of computers because of the ready availability of a wide variety of compatible software that is carefully prepared and effective" (p. 242).

Komoski (1984b) recommended that educators (a) search for and purchase only the best software, using reputable evaluation sources and local input; (b) provide teachers with information and training that helps them use the best software effectively; (c) focus on the community, involving parents and community members in selecting software and hardware for home use--raising everyone's awareness; and (d) through networking efforts, help low-income families have access to software and hardware, as well as training.

Washgal (1984) addressed the urgency of incorporating computers and software into the schools while the reform era provides an encouraging climate and argued that the best educational and administrative uses of computers have yet to be tried.

> Twenty years from now, when interactive electronic technology has entered every nook and cranny of American life, the U.S. school may still be conducting business as it does today. Should that be the case, . . . the schools, still relying primarily on paper and pencil exercises, will have little choice but to serve as holding tanks for youngsters who are receiving the profoundest aspects of their education in other quarters. (p. 254)

Policy Issues Related to Instructional Hardware

There is no one correct answer for selecting and purchasing hardware for a school or district, but most experienced computer experts agree that the software used should dictate the hardware to be acquired (Hofmeister, 1984). Because computer systems and peripherals are not always compatible, and certain software is not compatible with all hardware, educators must make perplexing decisions about what to select. It is an "educational process for a school or district; one not to be avoided," suggested Hofmeister, who recommended these steps:

* The major purpose should first be identified.

* Identify the best software.

* Identify hardware to support the selected software.

* Purchase systems, not components in isolation.

* Cost considerations: The most neglected cost factor is the software. Over time, 75 percent of the costs of microcomputer systems will be tied to software.

* Standardization of equipment is rarely a cost-effective approach. There may be a vast difference in the software and hardware requirements of elementary school CAI, junior high computer language instruction and high school business education. (pp. 8/13-14)

In spite of all this advice, when a school or school system has decided to begin an instructional computing program, a frequent first step has been to accumulate equipment. Lindelow (1984) suggested that unless a system employs staff who have had experience with computers, the school should seek help from a consultant in a service district or from an appropriate agency.

The Principal's Planning Guide for Microcomputers (1983) called any equipment acquisition unfortunate, unless it is preceded by proper planning related to purpose, followed by choosing software, hardware, and finally planning for ongoing inservice. Johnson (1983) reviewed considerations for school leaders to confront, all based on the instructional objectives extant:

1. Will the computer or computer system have the capabilities to meet requirements?

2. Is the software needed compatible with the system(s) chosen?

3. What physical facilities must be built or adapted? How many peripherals must be acquired?

4. Is the computer the most cost effective way to deliver the instruction?

5. Is the computer compatible with other equipment in the district?

6. What is the life span of the equipment and peripherals?

7. Are vendors reliable?

8. How available is maintenance?

9. What purchasing and funding options are available?

10. What user groups will have access?

11. What applications will be considered?

Becker (1982b) reminded educators of the realities of microcomputers as machines or objects in schools. Even though prices of microcomputers are decreasing, schools, dependent upon available software, are unable to repurchase each new and improved model that arrives on the scene, will contain an older technology.

<u>Funding and Focus as Policy Considerations</u>

In an analysis of funding required to implement and sustain an instructional computing program, Moursund (1984c) believed that a school district needs to make a commitment to a permanent level of funding for (a) hardware, (b) software, (c) inservice and continuing training, (d) a computing coordinator, and (e) a contingency allocation for additional inservice, remodeling, accessing video, and community use.

Among the financial questions that arise when a school board, district, or school commits to an instructional computing program for staff and students are: Obsolescence: The technology is changing so rapidly that microcomputers and related equipment have become more powerful and less expensive, which means that two-year-old equipment could be obsolete and maintenance difficult to obtain. Standardization: Incompatibility of systems is common, even among models produced by the same manufacturer. Cost: Even with costs of computers lowered, a computer for every child, if desirable, would be financially impossible for most publicly funded school systems. Cost-effectiveness: The computer is not a panacea (Lindelow, 1984). "They may not be beneficial in particular situations" (p. 27). In addition, the use of available computers should be maximized.

The initial purchase of equipment and software is only the beginning of expense. Funding must provide for maintenance, replacement, and allowance for the expansion of technology (Chion-Kenney, 1985). Morsund (1984c) noted that only 1% of school funds across the nation are allocated to educational technology. He recommended a school commitment to an annual expenditure of 2% of budget for equipment, software, maintenance, training, and peripheral components.

Without question, reported Howe (1984a), funding is the primary issue in providing equitable educational opportunities to all students. Yet the disparity in funding is exemplified by the fact that in 1982 New York spent $3,769 per pupil, while Mississippi spent $1,605.

Stronge (1983) listed other possible funding sources, such as Chapters I and II of the Education Consolidation and Improvement Act of 1981, or Part B of the Education of the Handicapped Act, foundation grants, endowments, and gifts of parent and civic groups. Only Florida, to date, has mandated the inclusion of educational computing in public schools (Ragan, 1983).

Funding considerations must take into account the school's mission and commitment, or focus. For example, Minnesota has made a long-range commitment to school improvement through the establishment by the legislature in 1971 of the Council on Quality Education. Sattel (1983) reported that the Council brought the "microcomputer age into education in 1977" and pointed out that Newsweek magazine (11/22/82) indicated that Minnesota is leading the country in development of microcomputer applications, and we are!" (p. 1). Even when a commitment and effort are made to bring computers and effective instructional software to all students, Sattel reported a problem of distribution that is presently being addressed: Some schools had one per classroom, whereas other school districts owned only one or two machines.

An overarching concern of many educators has been that the commitment to means will produce equitable outcomes for all.

A Brief Overview of the Arrival of Microcomputers and the Implementation of Educational Computing in Michigan Public Schools

The discourse in this subsection is limited to a review of selected representative instructional computing activities and concerns that were reported to be present in Michigan public schools before 1984, when the present study began. Selected issues related to K-12 computing in schools across the United States have been reported in this chapter.

In Michigan K-12 education, the Blueprint for Action (Michigan State Board of Education, 1984) is the most publicized and official recognition and acceptance of the incorporation into school settings of instructional computing and related technologies. A comprehensive response to national calls for reform, it contains long-range recommendations to the legislature, to higher education, to intermediate school districts, and to public schools.

Technology-related recommendations include: (a) one-half year of computer science for all high school students; (b) the upgrading of training of teachers and administrators through inservice; (c) the development of standards of certification for teachers who teach the computer sciences; (d) proposals for the funding of computer software acquisitions, for training, and for equipment purchases for schools; (e) provision of a resource center for educators; (f) development of an experts' resource bank; (g) acquisition and dissemination of a variety of models; (h) the integration of computer awareness in technological career areas, and (i) the promotion of information networks.

Significant to the present study was the recommendation for the "assessment of the status of instructional computing activity in the schools of Michigan" (emphasis added).

Michigan educational computing pioneers, involved in some of the initial electronic learning activities, were frustrated in their early program-implementation efforts by the poor content and quality of available software. In an effort to find or develop appropriate courseware for students, members of a number of Regional Educational Media Centers (REMC's) across Michigan collaborated to resolve this challenge through a networking consortium called Project WE CAN (Zolton, 1983). WE CAN was a first statewide major rallying point for educational computing professionals in Michigan's geographically far-flung school districts. WE CAN has become one symbol of the unifying acceptance of and commitment to educational computing in Michigan:

> With the proliferation of microcomputers, especially applications in education in the last two to five years, there has arisen a tremendous need for coordination, systematic planning and technical assistance. . . . The project [has] made considerable progress toward identifying and exchanging information about microcomputers to potential users.

A more recent project, M*STAR (1985), will extend and enhance the statewide computer networking concept by using satellite television through intermediate school districts and local schools.

With the exception of Minnesota, which as early as 1976 made dramatic strides in statewide educational computing services through the Minnesota Educational Computing Consortium (MECC) (Rawitch, 1982), there has been only negligible involvement by states in the early promotion and diffusion of educational computing opportunities for students. More recently, the Michigan State Department of Education employed a mathematics/technology consultant. By 1985, it had appointed a full-time educational computing consultant.

The Michigan Department of Education's Office of Grants Coordination and Procurement (1984) provided discretionary project grants to encourage, among other initiatives, the development of computer literacy projects. The State Library of Michigan has continued to offer a microcomputer and software demonstration center in Lansing. In late 1984, five software review and demonstration centers were piloted within some of the intermediate school districts. At the same time, Training of Trainer Models are being formulated at the University of Michigan (1985) with the collaboration of the Department of Education.

A multifaceted training, demonstration, and assistance program, called the Tri-County Computing Consortium, was established in the early 1980s to accommodate teachers, schools, and districts engaged in computing projects with students in Michigan's three most densely populated regions, Wayne, Oakland, and Macomb Counties (Johnson, 1983).

Developing model dissemination projects for adoption by local schools is an as-yet-unfinished plan. Initiated in 1982-82 and coordinated by Dr. Carl Berger, it brought together a team of educational computing experts to work on school computing models.

Elementary teachers interviewed informally (Bancroft, 1983a) reported that a preponderance of their students obtained their early encounters with computers at school sites when teachers, community members, or administrators brought their personal computers to school to share or helped raise funds to obtain a "first" computer. These grass-roots efforts often were catalysts for school boards to initiate educational computing programs.

An example of the ground swell of activity among Michigan educators is the Michigan Association of Computer Users in Learning (MACUL) (Checkpoint, 1984). In 1979 12 computer-proficient educators from various school sites in southeastern Michigan were working individually to promote some uses of microcomputers for their local students. Their need to obtain ideas and their willingness to share information about student educational usages of computers inspired them to form a support group. By 1984 the membership of MACUL had risen to over 6,000 educators. An annual MACUL conference preserves the idea-sharing concept and is attended by thousands of educators.

Local schools and districts that have developed descriptive materials or exemplary programs and practices have tended to share their expertise in writing or in workshops, or have encouraged other schools to visit their sites. A few examples include a well-developed staff inservice model from Troy, Michigan, Public Schools (Shotwell, 1983); a frequently visited school system in Birmingham, Michigan, which in 1981 began developing a K-12 curriculum-integration model (Bancroft, 1983a); a useful plan for scheduling computing in an elementary school environment (Burleigh, 1985); and a demonstration site for the use of videodisc technology in relation to students' individual learning styles (Billings, 1983).

Project Best Bet (Ainsley, 1983) involves a local blue-ribbon committee with a national effort to make the best use of technology in schools. Eventually a multistate regional center will provide local schools with pertinent research and practice information related to instructional computing.

In 1983, over 85% of the Chapter II Educational Consolidation and Improvement Act (ECIA) funds in Michigan were requested for use by school districts to purchase microcomputers and associated materials. Salas (1983), then president of the Michigan State Board of Education, cautioned that many Michigan pupils at that time had not gained access to the new technologies and emphasized:

> Equity of access has, therefore, two aspects: the availability of funds to the local district, and the collective wisdom of the local school board, administration and teachers in planning for immediate and long-range acquisition and use of the new technologies. (p. 9)

The level of integration, implementation, kinds of uses, and the diversity of policy and practices at work across community types are not yet well documented. The documentation that is available about Michigan's local school efforts records a variety of local school and district responses to the press for change to address the new technologies, especially computing (Bancroft, 1983b; MACUL Newsletter, 1985). Salas stated that "unless we can find a way . . . to balance the cost of technology with the diverse economic status of our schools, we are going to be faced with what will become the educational access crisis of the 80's and beyond."

In a 1984 survey of educational computing across the United States, Market Data Retrieval Services (MDR) (1984) reported 15,421 microcomputers installed in Michigan's 3,319 public schools. Of those, 6,100 were located in the state's 2,083 elementary schools. In a state ranking of 50 states and Washington, D.C., MDR cited Michigan as seventh in size of enrollment, fourth in number of computers, fourteenth in percentage of districts using microcomputers, and eleventh in percentage of public schools using microcomputers.

Lezotte (1985) suggested that a school staff, when determining its instructional focus or mission, should ask:

> What do we want our students to know and be able to do when they complete their K-12 schooling? How many students do we expect to learn what it is that we want them to know and be able to do?
>
> . . . When formulating a policy for K-12 education within a school district, school decision-makers base their instructional focus upon the answers to these questions. Then the means or resources are delegated to achieve the stated ends. (p. 1)

Summary

The review of related literature encompassed (a) the demands of a new and changing technology on society and educational institutions, (b) an overview of current implementations of microcomputers in education, (c) student learning with and about microcomputers, (d) educational policy issues and realities related to microcomputers, and (e) a brief overview of the arrival of microcomputers and the implementation of educational computing in Michigan public schools. In their totality, these subsections set the stage for an investigation of the integration and student use of microcomputers in Michigan elementary schools.

CHAPTER III

DESIGN OF THE STUDY

Introduction

The specific procedures and methods used to answer the research questions posited in this descriptive study are presented in Chapter III. The study was designed to collect descriptive data, systematically, statewide, which would provide information on the kinds and levels of student use of instructional computing in Michigan rural, suburban, and urban public elementary schools. An analysis of such data, it was proposed, would provide significant information about the current direction and extent of policy and practices related to instructional computing in Michigan public elementary schools. A second tier of the study incorporated a survey questionnaire interview administered at six school sites. The descriptions of schools and responses of interviewees at school sites, it was believed, would enrich the data from the statewide survey.

These school sites were carefully selected from all respondents to the initial statewide survey, or Questionnaire Number One. Before the generation of the statewide and on-site survey, an opinionnaire was constructed and sent to educational computing experts. The opinionnaire helped ground the content and criteria for the entire study.

The purpose of descriptive research is to portray accurately and objectively current conditions. It can include surveys and interviews. Sax (1979) reported that descriptive research often has its greatest value at the beginning stages of an investigation. It can be surmised that the advent of the innovation of instructional computing in public school settings presents such a beginning stage and that the present study's attempt to describe the status of this development may be appropriately served by descriptive research.

Population and Sample

The population surveyed in this study were elementary principals. They were believed to be the building-level persons most likely to have knowledge of, or access to, the information called for in response to the survey questions.

A sample of 600, approximately one-fourth, of Michigan's public elementary schools was randomly selected to receive and respond to the first mail survey questionnaire, Questionnaire Number One. To assure a fair representation of rural, suburban, and urban school sites, 200 schools were randomly selected from each of those general categories. These community-type categories were so designated by the Michigan State Department of Education (1971). (See Appendix A for the Department's "Definitions of Michigan School Districts by Major Community Types" and a map indicating the Department's "Region and Community Type Categories.") The schools, randomly selected, were from the following strata: Urban I, Tri-County, which includes Wayne, Oakland, and Macomb, with Urban III, Urban Outstate; Suburban II, Town and Urban Fringe of Tri-County Area, with IV, Urban Fringe Outstate; and Rural.

By using the strata designations most frequently used by the Michigan Department of Education in its experimental testing programs, the study's sampling process had its foundation in a procedure that had proven effective during a 15-year span. Guidance in selecting and sampling the population was provided by the current directors of the Michigan Educational Assessment Program and the Office of Technical Assistance and Evaluation, respectively.

The population for a second tier of the study, in which six school sites were selected to participate in an on-site interview process, included a principal, two teachers, and a district-level administrator or district computing consultant, if one had been appointed. This second sample was chosen after a purposeful scrutiny and carefully derived elimination process applied to all returned surveys. Two rural, two suburban, and two urban schools that evidenced high levels of use and access to educational computing activities for all or most students were selected for a more in-depth, on-site interview activity. The criteria for selecting these six elementary schools are described in the Methods and Procedures section.

Sax characterized the interview as a "direct attempt by the researcher to obtain reliable and valid measures in the form of verbal responses" (p. 233). The survey data obtained from the interview, it was believed, would help clarify and also provide a more measured emphasis to the assumptions and conclusions drawn from the topical literature extant and from the findings produced from an analysis of written responses derived from Questionnaire Number One.

Methods and Procedures

The focus of the study developed from the interesting conclusions reached in a field-based research project completed as a requirement for the Education Specialist degree (Bancroft, 1983a). That research described how three K-12 school systems in southeastern Michigan integrated instructional computing into their schools. Those school districts, each evidencing varied levels of resources and commitment, even though in different cycles and with diverse means and methods for meeting their objectives, promoted a process and program that encouraged a high level of access and participation computing opportunities for most students. Certain characteristics appeared to be present in the schools and the districts that facilitated the implementation and integration of computing across grades and across the curriculum. For example, an in-school computer enthusiast nearly always was a present influence.

A major purpose of the study was to ascertain the level of access and kinds of instructional computing uses afforded to elementary students in a large cross-section of Michigan public schools. To derive feedback that would be informative to educational agency planners and local educators, the questions developed for the first survey required a foreknowledge of what kinds of activities might be present. In the initiating stages of the present study, an opinionnaire directed to educational computing experts verified the presence of certain characteristics when a "high degree of access and participation opportunities for students prevailed." To deliver a questionnaire with appropriate content, an opinionnaire was distributed to 17 educational computing experts and professionals from Michigan and elsewhere, who listed and then ranked from five to seven characteristics they believed needed to be present in a school or district striving to promote a robust and inclusive instructional computing program. Their responses, unweighted, were listed, categorized, and then ranked by mean from the highest to lowest response rate, according to those attributes most frequently mentioned. These ranked responses were an influential factor in formulating the questions for the first and second survey questionnaires. Table 1 presents these attributes.

The statewide survey, prepared to collect descriptive data from a sample of 600 rural, suburban, and urban elementary schools, used the input from the opinionnaire just described and from general instructional computing surveys extant, as well as from the questions posed in summary sections of current research studies. These are described in the section entitled Instruments.

The initial survey instrument was sent to five practicing instructional computing consultants for feedback. The survey instrument was revised and refined to incorporate appropriate recommendations, and following that revision was sent to five Michigan elementary principals for piloting to test its ease of completion, its inherent appropriateness to the status quo, and its overall meaning and orderliness. (See Appendix B for letter to the consultants and the principals.)

Table 1.--Educational computing experts' ranked opinions of characteristics most often present in a school or district where high access/participation opportunities are provided for students (respondent rate of return = 83%).

Characteristic	Percent
Administrative or principal support, involvement, encouragement	93%
Adequate funding	64%
Continuing & appropriate quality inservice	50%
Enthusiasm for computers & computing by leaders, teachers & students	50%
Well-detailed plan for integration of computers into curriculum	43%
Adequate to ample number of computers for students and open access to them	43%
A computer consultant or leader on local or district staff	36%
High expectations for educational computing & commitment to concept & funding by school board	36%
Broad range of applications visible; emphasis on applications	29%

Following these refinements, the questionnaire was reviewed and approved by some committee members and by the present directors of the Michigan Department of Education's Office of Technical Assistance and Evaluation and the Michigan Educational Assessment Program. At that juncture the questionnaire, with a cover letter, was mailed with a return stamped envelope to 600 elementary school sites, with the assistance of the Michigan Department of Education. (See Appendix B for the Survey Questionnaire and accompanying letter of explanation.)

For the second tier of the present study, additional and reinforcing questions were included to reach a specific target population: the principal, two classroom teachers, and either one computing consultant, if such a position had been established, or a district administrator. The responses to the three instruments prepared for the second tier of the study, it was anticipated, would provide information and insights that could not be characterized by the single word or quantitative responses gleaned from answers to items in Questionnaire Number One. The interview questionnaires provided the respondent and investigator with a structured format for interaction. The commentaries provided ample opportunity for open-ended responses. The principal was requested to select teacher respondents who would represent a cross-section of staff, either by grade level or by an interest or even an aversion to the topic of educational computing.

Each of the six school-site surveys was conducted in less than one school day, usually within three to four hours, and with specific interview time limitations prescribed by the host school. Tape recordings, subject to the consent of the individual, were made of some interview sessions, where time did not allow for completion of the structured interview format.

The procedure that was finally chosen for selecting the six schools of interest evolved through at least a half-dozen trial formulas.

It is important to note that the mere presence of numbers of available computers at a school site frequently has little or no correlation to high access and use by students. And although common sense would permit readers to know this is true, in the spirit of true research, two or more attempts were made in this study to numerically link higher numbers of computers to higher student use. In selecting high-use sites, what ultimately proved to be a helpful procedure derived from many "what if" conversations with knowledgeable committee members, as well as local public instructional support personnel.

The six elementary school sites selected for on-site visitation were derived by means of dividing the responding schools involved with the statewide questionnaire, the first survey, into nine sectors. Across the three school types, rural, suburban, and urban, the schools were ranked ordinally by the number of microcomputers they dedicated to student use and then by the ratio of students to one computer at that school site. The 25% of the schools with the highest number of computers for per capita on-site student use were labeled high availability. The 25% of the schools with the lowest number of computers for per capita use by students were labeled low availability. The 50% of schools whose ratio of students to one computer fell between the high- and low-availability range were labeled moderate-availability schools.

Separating the schools into their rural, suburban, and urban types was a decision that stemmed from the belief that the purpose of the survey would be better served if readers of the final survey data could review it in the context of a geographic demarcation of interest to their special needs.

Once having the school sites ranked by the ratio of students to one computer, it then became possible to begin looking for schools that would also evidence higher degrees of student participation than other schools. These schools were able to report a high degree of student use time. The criterion selected was that educationally dedicated computers were used within the school day between 76% and 100% of the time. Thus, time use was the basic criterion for initially locating the high-participation school sites.

To further refine the process of locating high-access/ participation schools, responses to several other questionnaire items were reviewed and considered. These additional criteria provided a way to obtain those school sites for study that would be not only high users, but would be serving the greatest number of students across grades and doing so with the widest range of locally appropriate materials and curriculum content. To enumerate, the considerations for selecting schools for further study included: (a) a higher number (than most schools) of computers for student use; (b) the fact that all available computers were in use 76% to 100% of the time; (c) most grades and a majority of students were included in planned instructional computing activity; (d) a broad and expanding range of applications and activity were reported; (e) individuals and groups beyond the general education students were included; and (f) an ongoing and articulated plan, either at the school or district level, was manifest. Also contributing to a high-access and high-participation climate was evidence of placement of computers for guided use before or after school, during recess and lunch breaks, or for check-out by parents, teachers, and students on week-ends and vacation periods. All these factors were considered.

The returned questionnaires having been ranked by ratio of students to one computer were then subsequently arranged in a descending order, based on availability in relation to maximum student time/use of computers as described previously.

Through this method, schools could be grouped within their rural, suburban, and urban categories in yet even more definitive groupings. It was now possible to cluster in the following way: (a) high computer availability/high use; (b) high computer availability/moderate use; (c) high computer availability/low use; (d) moderate computer availability/high use; (e) moderate computer availability/moderate use; (f) moderate computer availability/low use; (g) low computer availability/high use; (h) low computer availability/moderate use; and (i) low computer availability/low use.

This sorting process provided a way to view the returned survey data in light of access and participation. Also, it permitted interesting and innovative efforts and activities to surface, which otherwise might have been minimized or overlooked. As an example, a variety of innovative strategies were identified in schools with moderate availability of computers but with high use. Such ideas could be transferable and helpful to other school sites, whose few computers could be perceived as an otherwise limiting factor.

The procedures and methods enumerated permitted the research questions to be addressed in a clear and uncomplicated way. Of current interest to educational planners and researchers appear to be some of the following: (a) what, basically, schools are doing to implement change; (b) what it is that local educators believe students need to know about and do with microcomputers; (c) what policy decisions are being made that affect this activity; and (d) what assistance or ideas seem to help local schools and districts do what they believe needs to be done, related to instructional computing.

The six schools selected for visitation exhibited a climate of high access and participation opportunities for students and teachers and met the criteria within their school type of high or moderate computer availability for students. They also reported instructional use of all computers during 76% to 100% of the school day.

Research Questions

Of interest in this study were the following research questions. They represent topics that are of current, general interest to educators across states and districts, but for the purposes of this study were limited to responses from Michigan rural, suburban, and urban public elementary schools.

1. What is the representative level of integration of microcomputers dedicated to educational usage?

2. What can be described as the level of instructional computing access and participation opportunities for students across grades and groups?

3. What educational applications of microcomputers are most generally present for students?

4. What local policy decisions are being developed or are in place to assure students instructional computing (or technology) opportunities?

Related Research Questions

Four of the questionnaires developed for this study--the statewide survey, the on-site principal questionnaire, teacher questionnaire, and the computing consultant/district administrator questionnaire--provided many "state-of-the-art" answers of an inventory nature about what elementary schools, and to some extent their staffs and districts, are presently doing to incorporate an innovation. Because a descriptive study can provide useful planning and trend data, even when not fully generalizable, the feedback, which was deemed to be of general statewide interest, was selected and reported.

The following additional questions were either discussed or interpreted in graph or tabular form. (See Appendix B for copies of the surveys.)

5. What funding sources are used to provide hardware, software, and computer-related acquisition and maintenance?

6. What are prevalently preferred physical placements or locations for microcomputers?

7. Are there expectations by middle schools that elementary students will have achieved certain instructional computing skills and understandings?

8. Are students' computing skills and understandings formally measured?

9. Other than general education students, do any groups of students have access to instructional computing? If yes, which groups or individuals?

10. Are any computers dedicated to school administrative tasks or computer-managed instruction?

11. How many pieces of instructional software are currently found, on average?

12. What is the content or delivery system used by a district or school to promote inservice training and updating for teachers and staff?

13. On average, what percentage of staffs currently appear to be somewhat or highly qualified to teach their students with and about computers and computing?

14. How many schools have filled a position for a district or local instructional computing consultant?

15. Is there usually a building "expert" present who helps or inspires students or staff to get involved in educational computing?

16. Is there an intermediate school district computer consultant regularly available to teachers?

17. Is there a general level of enthusiasm for computing among district administration, students, teachers, or parents?

The final question posed was framed to capture from the six on-site interviews any evidence that might highlight successful practices, unique efforts, or distinctive characteristics at the schools visited.

18. In relation to instructional computing opportunities for students, are there distinguishing characteristics present locally that appear to foster a climate of high access/participation opportunities for most students? The discussion of this question is contained in Chapter IV in the subsection entitled Six Site Visitations; findings are briefly summarized in Table 27.

Instruments

The instruments used to effect the present study included an opinionnaire, a statewide survey, and an interview questionnaire developed in three forms and modified to provide sense-making items for (a) a local building principal, (b) classroom teachers, and (c) a district administrator or district computing consultant. These instruments were created specifically for this study. They were carefully designed to collect data and provide feedback on desired information. Care was taken to develop an instrument that was both brief and understandable.

The statewide mail survey was piloted and revised based on input from principals, computer consultants, educational computing experts, and statistical advisors, and by adapting similar content found in relevant published surveys or research studies. In addition, the feedback from the opinionnaire, completed by 14 instructional computing experts, supported the types and content of questions selected. All instruments were pilot tested by representative potential recipients of each questionnaire type.

In addition to professional journal summary articles on educational computing practices, a number of current research studies and recently developed educational computing assessment instruments more specifically influenced the content of questions in all categories of interest. The most frequently used were: the Rand study, "Successful" Teachers' Patterns of Microcomputer-Based Instruction (Shavelson et al., 1984) and Computer Literacy: Definition and Survey Items for Assessment in Schools (Lockheed et al., 1983). The latter assessment instrument provided questions derived by a team of experts whose work was sponsored by the National Center for Education Statistics.

Questions for further study found in the work of Becker (1984b), Hall (1981), Sheingold et al. (1983), and White (1984) were selected, adapted, and integrated into the study. Guidelines for developing the questionnaire were adapted from Designing and Utilizing Mail Questionnaires in Educational Research (Humphries, 1983). Overall guidelines for developing the design were derived from Summing Up (Light & Pillmer, 1984).

Analysis of the Data

The information collected from the statewide survey was coded by item response number to produce an item-by-item breakdown for all answers of interest and, further, to enable a reporting by community type: rural, suburban, or urban. Some items required only simple reporting of totals; others were totaled and then averaged. For example, the number of computers for educational purposes in all elementary schools sampled required only a simple total. If, however, it became of interest to determine how many schools, on average, used the instructional application of word processing in language arts, composition, and reading as compared to those using mathematics drill, a mean score might be reported.

The summaries of data gathered from interviews conducted at each of the six selected elementary school sites were limited to remarks and responses pertinent to the locally computer-relevant practices and adaptations reported individually by the local principal, the two teachers, and either a district administrator or computer consultant. The decision to use and report only descriptions of information germane to the process of adaptation to an innovation and observed facilitating practices, rather than pursuing all possible discussion points, was influenced by the work of Downie (1976).

The data from the six school-site summary interviews were organized in the following manner: a description of the school, its clientele, the computer-related activity, and a brief delineation of those elements, policies, practices, or local attitude that distinguish it from other schools that also, according to survey results, evidenced a high degree of educational computing opportunities for most students. The differences, rather than the similarities inherent in these schools, were believed to provide the most interesting commentary.

Summary

The major purpose of this study was to obtain descriptive data, systematically, from an equal sampling of rural, suburban, and urban Michigan public elementary schools, which might provide information about the kinds, levels, and intensity of educational uses of microcomputing by students. This chapter described the sampling procedures, the instruments that were formulated and used, and the methods and procedures developed for effectuating the study and ultimately reporting the findings.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

A major purpose of this study was to collect pertinent data that would help identify the levels of student access to, and use of, microcomputers in a sampling of Michigan rural, suburban, and urban public elementary schools, and to seek to provide information about individual school or district policies and practices that have been developed and that appeared to promote the growth of an emerging technological innovation.

Chapter IV is arranged in the following manner: first, a discussion of the ranked responses of an informal opinionnaire requesting viewpoints from educational computing experts; second, the presentation of data retrieved from reporting principals in a statewide survey of 600 elementary schools; and third, a summary of observations and feedback from visits and interviews conducted at six selected school sites. The interviews were addressed to the local principal, two teachers, and a computing consultant or district administrator. In most cases, four interviews were conducted at each of the selected school sites.

The Opinionnaire Sent to Educational Computing Experts

Before the preparation and distribution of the statewide questionnaire, an opinionnaire was sent to a variety of professionals involved in educational computing. They have, for the purposes of this study, been called computer "experts." Their qualifications derive from one of the following: (a) their active involvement in teaching educational computing to teachers and administrators, (b) their research in the field of K-12 educational computing, (c) their position description as a public school educational computing teacher of students, (d) their reputation for publishing in that content area, and (e) in all cases a five-year or more acknowledged leadership role in educational computing.

Of the 17 experts contacted by mail (see Appendix B for the letter to the experts), 14 responded. They were asked, "What characteristics do you believe would be most often present in a school or school district where high degrees of access and participation educational computing opportunities for students prevail?" Their responses, categorized and ranked, provided the grist for content of questions selected for the statewide questionnaire and subsequent school-site interviews. A review of their ranked responses follows: (a) administrator or principal support, (b) adequate funding, (c) continuing quality inservice, (d) enthusiasm for computers among staff and students, (e) a well-detailed plan for integration, (f) adequate to ample numbers of computers and fair access, (g) a consultant or leader at the local/district level, (h) high expectations for educational computing by the school board, and (i) a broad range of applications visible. These ranked attributes were fully described in Chapter III in the discussion of the instrumentation.

The Statewide School Survey

Population and Sample

The first survey, mailed in April 1985 to 600 elementary school principals, produced by the return deadline 361 responses, a 60% response rate. Although not included in the formal study, a dozen or more late responses were received, containing no extreme variations in overall input from those in the coded responses noted.

When sorted by the three community types sampled, the responses revealed a representational balance of approximately one-third from each sector. Each community type was sampled to produce a potential response of 200 schools. In the 600-school survey, 200 questionnaires each were sent to rural, urban, and suburban schools. Table 2 indicates the frequency and percentage of return rate from all schools, categorized by community type.

Table 2.--Number of elementary schools responding, by community type.

Community Type	Frequency	Percent All Cases
Rural	126	34.9%
Suburban	129	35.7%
Urban	106	29.4%
Total	361	100.0%

School population sizes varied significantly. For example, one rural elementary school claimed only 18 students while another reported over 900. Suburban schools ranged in size from 71 to 900 students. Urban schools ranged from 135 to 934 students. The mean school population for rural schools reporting was 322; for suburban, 407; and for urban, 429. The mode for all community types was between 300 and 330 students.

It was possible that more than one elementary school in a given district provided data for this individual school survey. This fact would only influence information that inquired about district involvement. In all cases, that influence was acknowledged in the reporting. Table 3 portrays the district relationship of the schools responding to the present survey.

Table 3.--Number of possible elementary schools in the districts of the responding elementary principals.

Community Type	Range	Mean	Median	Mode
Rural	1-14	2.8	2	1
Suburban	1-25	6.7	5	4
Urban	1-167	51.8	20	167

The elementary schools surveyed in the present study were drawn from a sample of all Michigan public schools that contain a grade 4. As a result, 1,892 schools were potential respondents. The random sample of rural elementary schools was drawn from 521 possible sites, the suburban sample from a possible 804 schools, and the urban sample from a possible 567 schools. For convenience, the study samples were drawn from the lists used by the Michigan Department of Education for the fourth grade Educational Assessment Program (MEAP).

Within Michigan's 83 counties there are approximately 594 school districts, with the following designations: Community Type I, Metropolitan Core; Community Type II, City; Community Type III, Town; Community Type IV, Urban Fringe; and Community Type V, Rural. (See Appendix A for definitions of school districts by major community type and designation of community type.) Depending on the criterion used, the number of public school districts reported for Michigan may vary. For example, some districts may not be officially classified as school districts because they do not contain all grades K-12.

In a recent study, Lipsitz (1982) reported as many as 35 varying configurations of possible grades included in a middle school. A similar pattern also characterizes elementary schools in Michigan. Combinations of grades noted in the responses included several schools containing all grades, kindergarten to 12 (K-12), housed in one building; at the other extreme were schools with only one or two grades per building. It was expedient to code data for the present study in such a way that it would be representative of most school populations in Michigan. To this end, all elementary schools were categorized into three clusters that embraced most of the possible combinations of grades K-6 as follows: kindergarten through grade 2, grade 3 through grade 5, and grade 6 through grade 8. Each principal respondent reported on a checklist all the grades contained in his/her school building, and the total number of students in all of the grades designated by this investigation as elementary grades: K, 1, 2, 3, 4, 5, and 6, or any combination thereof.

All respondents reported their grade configurations. Ninety-six percent contained grades K, 1, and 2; 98.9% contained grades 3, 4, and 5; and a little over half, or 56% of the schools, reported a sixth grade. The most common grouping of grades within the typical Michigan elementary school surveyed appeared to be K-5.

Responses to the Major Research Questions

Research Question 1: What is the representative level of integration of microcomputers dedicated to educational usage in a sample of Michigan public elementary schools?

In the 361 elementary schools surveyed, the total number of computers dedicated to student educational uses was 2,749. Table 4 presents the spread of the data across the 361 schools reporting.

Table 4.--Number of educationally dedicated microcomputers for student use at 361 Michigan elementary school sites.

Community Type	Mean	Median	Mode	Number of Micros
Rural	6.6	5	5	829
Suburban	9.7	8	6	1,256
Urban	6.3	5	2	664
All schools	7.6	6	6	2,749

In a recent survey of 2,337 U.S. schools, January to June 1985, Becker (in Chion-Kenney, 1985b) discovered that those elementary schools now have, on average, at least five microcomputers. Across community types in Michigan it appears, then, that Michigan elementary schools with an average of almost eight microcomputers per school have achieved a higher acquisition level than the national estimate of five per school.

Ten schools, or 3.5% of the 361 schools reporting (4 rural, 2 suburban, and 4 urban), reported no computers at their school site. Becker found that nationally 12% of K-12 schools had no computers, and another 6% had only one computer.

To determine further the level of integration of the computers into the instructional program of schools, the question was asked: "What is the ratio of students to educationally dedicated computers in your school?" Table 5 portrays a purely mathematical ratio obtained by dividing the total student population by the number of computers available. That is, under optimum conditions of use and access, how many students to one computer would there be? It is important to note that principals sometimes qualified their ratio for reasons such as "Kindergarteners do not use computers, which reduces the ratio"; or "The computers are used only by Chapter I students, not by all students." However, for purposes of this study, the number of computers at a site and the total number of potential student users was set as the criterion. Which students actually used computers is discussed elsewhere in the study.

Table 5.--Approximate ratio of students to one computer in a sample of Michigan public elementary schools.

Community Type	Mean	Median	Mode
Rural	76	55	50
Suburban	53	44	25
Urban	118	79	0
All schools	80	50	50

What that ratio indicates for student users is not clear until the additional factors of use-time and access to computers are ascertained. If average class sizes range from 25 to 35 students, for example, a school with 325 students and four computers would be exceedingly challenged to schedule students and teachers for both maximum time and quality usage.

A second major research question asked:

> Research Question 2: What can be described as the level of instructional computing access and participation opportunities for students across grades?

Responses to the first research question illuminated two areas of interest: first, the degree of success with local efforts to acquire computers; and second, a count of actual numbers of computers located in a sample of Michigan public elementary schools. Question 2 focused on who uses computers and how they are made available to all, or most, students. The survey posed several questions to retrieve this information. First the survey asked how many grades were in the school, and of those grades, how many were exposed to educational computing and, beyond that, any planned instruction. In addition, principals were asked to report if all sections of the same grade received similar time allotments. Only those schools that offered planned instruction for students responded to this series of questions. (See Table 6.)

Table 6.--Numbers and percentages of schools, by community type, reporting planned instruction across grades (rounded to nearest percentage).

Grade	All	Rural	Suburban	Urban
K-2	183[a] of 271=68%	52/87=60%	82/108=76%	47/76-62%
3-5	262 of 271=97%	84/87=97%	104/108=96%	74/76=97%
6-9	134 of 271=49%	50/87=57%	43/108=40%	41/76=54%
Possible responses	361	126	129	106

[a]First number in each column indicates actual responses.

It appears that 68% of all schools reporting assured equal time and instruction across sections of the same grade. This fact is significant in thinking about equity of use and access, as well as content, and indicates a local attention to providing equal opportunity (Lautenberg, 1984).

Another indicator of a school's commitment to providing students with access and participation opportunities with microcomputers is the percentage of time during the school day micros are available for use. Table 7 highlights the responses to the question: "What percent of the time, do you estimate, all your computers are used instructionally during the school day?" Only 38% of the schools used their computers at least half of the available time during the regular school day. Ninety-six percent of the rural, suburban, and urban schools responded to the question.

Table 7.--Percentage of time computers are in use during school day (rounded to nearest percentage).

Percent of Time Used	All		Rural		Suburban		Urban	
	N	%	N	%	N	%	N	%
0-25%	141	41%	60	51%	42	33%	39	38%
26-50	71	21	17	14	30	24	24	24
51-75	67	19	24	20	28	22	15	15
76-100	67	19	18	15	26	21	23	23

Note: N = number of schools reporting in each category.

Because some computers were dedicated to special uses and special groups, it was important to inquire about the use of computers for general education students or all students. To the question "What percentage of your students use a computer approximately once a week?" respondents had the opportunity to express student use and access time in yet another fashion. Table 8 indicates, in a general way, a sense of how much time is meant by use-time.

Table 8.--Time allotted to student use of computers each week.

Time Allotted Each Week for Computing	Number of Students and Percent of All Students Offered Computing Weekly
15 minutes but less than a half hour per week	105 of 361 schools provided 50% of their students this amount of instructional computing time
30 minutes but less than one hour per week	62 of 361 schools reported offering 50% of students this amount of instructional time
One hour or more per week	14 of 361 schools reported providing 50% or more of their students this amount of computing time

The data presented in Table 8 indicate only a sampling from an array of varied responses across the spectrum of possible configurations. For example, some of the schools reported having only a few computers and providing them only for the "fifth grade all year." More than one principal reported assigning each classroom all the available computers for two weeks out of the school year. "Instructional computing time is done on a rationed basis, so all get some use and experience." That 357 of 361 schools responded to this question evidenced deliberate decision making about how, and to whom, instructional computing time was being allocated.

The question "Are students in any of the following categories provided computing time?" allowed respondents to identify activities for specially designated student groups, such as gifted and talented, Chapter I students, special education students, or others. The results, as indicated in Table 9, reveal that special groups of students were served. It is important to reiterate that certain computers in some schools were purchased with monies that restricted their use specifically to these groups.

Table 9.--Number and percentage of schools, by community type, providing instructional computing time to groups either as part of the general education curriculum or in addition to it.

Community Type	Gifted and Talented		Special Educ.		Chapter I		Other	
	N	%	N	%	N	%	N	%
All schools 303/361=84%	170	56%	200	66%	193	64%	31	9%
Rural 100/126=79%	51	52	63	63	73	73	9	9
Suburban 111/129=86%	68	61	84	76	60	54	8	7
Urban 91/106=86%	49	53	52	57	58	65	14	15

Related to access and use for students is a topic of frequent discussion in the related literature, the issue of where microcomputers are located. Becker (1984a) observed that there are not enough computers in most schools to help draw distinctions between "best" locations or best groupings for available machines. In Michigan elementary schools surveyed, more than one particular setting was advantageous.

Strategies to position micros for maximum use and supervision were frequently reported in written commentaries. Placing computers on carts for mobility was a popular option. The preferred locations of computers are reported in Table 10. In the schools reporting, over half (55%) housed their computers in more than one location.

Table 10.--Placement of micros and terminals in elementary schools.

Placement	All Schools		Rural		Suburban		Urban	
	N	%	N	%	N	%	N	%
Reporting:	337	93%	120	95%	122	95%	95	90%
Classrooms	219	65	89	74	81	66	49	52
Carts	175	52	64	53	66	54	47	45
Media centers	99	29	32	27	40	33	27	28
Labs	91	27	31	26	31	25	29	31
Other	29	9	12	10	3	3	14	15

The third major research question was:

> Research Question 3: What educational applications of microcomputers are most generally present for students?

To provide an overview of educational applications, a general question in the survey inquired: "Are computers used to teach instructional objectives in several curricular/instructional areas?" Table 11 suggests that in the 90% of schools reporting, at least 60% of them use computers to teach instructional objectives in more than one content area.

Table 11.--Number and percentage of schools, by community type, reporting yes or no to the use of computers to instruct in several curricular areas (rounded to nearest percentage).

Community Type	Responding		Yes		No	
	N	%	N	%	N	%
All schools	328	91	209	64	119	36
Rural	113	90	69	61	44	39
Suburban	121	94	84	69	37	31
Urban	94	89	57	61	37	39

The recent movement toward integrating computing into the curriculum followed an initial three-year thrust by many local schools to acquire computers and software (Association for Supervision & Curriculum Development [ASCD], 1985). "The highly structured and brief access to the computer that students and teachers commonly have clearly curtails or prevents the most promising applications."

Becker (in Chion-Kenney, 1985b) reported that researchers have had little time to develop an intellectual or empirical rationale for the educational value of computers. Moursund (1984e) admonished educators to try to understand how computers "interface" and affect the 3 R's. "The greater availability of computers actually tends to broaden the scope and nature of each of the Basics and places an additional burden on the educational system" (p. 4).

In spite of inconclusive evidence regarding student computer use and the resulting effects, local efforts evidence a movement toward expansion of applications across the curriculum. Thirty-five school principals took time to comment that their faculties were initiating an instructional plan in early 1985; this was in addition to 169 of 324 reporting schools that noted an instructional plan in place.

An extensive checklist was provided so that principals could note the various student educational uses of the available computers. A column was also included for principals to list other uses not mentioned in the survey. The "other" column was used less than 2%. Ninety-four percent of the responding principals marked multiple categories for a total of 2,228 replies. (See Table 12.)

Table 12.--Percentage of schools offering students educational computing opportunities in various content areas (response rate = 94%).

Content Area	All Schools (N=340)	Rural (N=119)	Suburban (N=126)	Urban (N=95)
Mathematics	91.2%	93.3%	89.7%	89.5%
Drill	79.7	79.0	84.9	72.6
Reading	77.1	71.4	79.4	80.0
Language arts	64.4	63.9	77.8	46.3
Tutorial	61.5	58.0	66.7	58.9
BASIC language	46.5	49.6	46.0	43.3
Problem solving	43.5	38.7	46.8	45.3
Social studies	39.7	46.2	42.1	27.4
Word processing	37.4	37.0	45.2	28.4
Simulations	34.4	35.0	39.7	27.4
LOGO language	30.0	28.6	34.9	25.3
Science	24.7	25.2	28.6	18.9
Decision making	23.2	24.4	21.4	24.2
Music/art	7.1	9.2	7.1	7.3
Library/ref. retrieval	6.5	2.5	8.7	8.4
Other programming lang.	3.5	6.7	1.6	2.1
Other educational uses	1.8	3.4	1.6	0.0

Principals were not provided an opportunity to separately check "computer literacy" or "awareness" as an application. One principal wrote it in.

Although it is apparent that the major uses of computers in elementary school continue to relate to content areas where drill and practice can be used, such as reading and mathematics (Becker, 1984a), the trend toward applications such as word processing for language arts, for example (Moursund, 1984e), are discernible in the data reported by principals.

These emerging trends caused one expert, quoted in ASCD Update (ASCD, 1985) to speculate that educational technology in schools might advance in spite of insufficient funds because people are too invested in its potential" (p. 8) to relinquish or shelve it, so early in its development.

The applications of computers in instructional areas demand adequate teacher proficiency with the machine and a knowledge of appropriate software, not to mention time and motivation for the needed efforts. Providing instructional uses for students cannot be separated from those who are responsible for delivery of instruction. That role, in the elementary school, is most often fulfilled by the classroom teacher. Related literature and studies have shown that others frequently assume or support this role, such as a teacher "buff," who might help both teachers and students, a media specialist, a paid or volunteer aide, a visiting consultant, or the principal.

But, in most cases, classroom teachers are responsible for teaching the intended curriculum (Becker, 1984a). Assuming this is true, it is important to ascertain just how teachers gain the appropriate computing technology. The survey inquired, "For teaching with and about computers, what percentage of your instructional staff do you perceive as somewhat qualified or highly qualified?"

All principals reporting perceived that about two-thirds of their teachers could teach the expected computer specifics prescribed for students in their school. (See Table 13.) The survey did not seek to discover how many teachers actually did so, or how constrained those efforts were because of inadequate numbers of computers or software, or the provision of minimal computing time.

Table 13.--Principals' perceptions of teachers' qualifications to teach the schools' specified computing curricula.

	All Schools		Rural		Suburban		Urban	
	N	%	N	%	N	%	N	%
Schools replying	314	87%	117	93%	112	87%	85	80%
% of teachers perceived to be highly or somewhat qualified		68		74		63		68

Principals acknowledged the role of the computer buff or enthusiast in generating local student and teacher involvement in school computing activities. Almost two-thirds of the schools identified such a person. Table 14 shows answers to the question: "Is there a building expert, either certified or noncertified, who volunteers or is paid to assist teachers, staff, or students with instructional computing?"

Table 14.--Schools reporting the presence of an on-site computer enthusiast.

Community Type	Schools Reporting N	Schools Reporting %	Yes	No
All schools	354	98%	65%	35%
Rural	123	98	60	40
Suburban	127	98	74	26
Urban	104	98	61	39

Another question related to educational usage asked: "When students formally learn about the computer, are learning outcomes measured and/or recorded?" If such a process is acknowledged, it tends to strengthen the local emphasis on student learning with computers. Only a few schools reported measuring such outcomes on a regular basis. (See Table 15.)

Some teachers interviewed for this study said that at present recording data and diagnosing student progress via the computer, using computer-managed instruction, is time-consuming beyond its value in the pressing priorities of an elementary classroom. Outcomes that do tend to get measured are the progress students make with isolated concepts in reading or mathematics. The progress students make while working interactively with computer courseware is difficult to measure in group settings. But experts say that more diagnostic and prescriptive program software is in the offing (ASCD, 1985).

Table 15.--Schools reporting learning outcomes for computing.

Community Type	Schools Reporting N	Schools Reporting %	Yes	No	Sometimes
All schools	336	93%	16%	50%	34%
Rural	114	90	13	54	33
Suburban	126	98	15	50	35
Urban	96	91	24	46	30

The fourth major research question concerned policy decisions and program implementation:

> Research Question 4: What local policy decisions are being developed or are in place to assure students instructional computing (or technology) opportunities?

Several of the "related" research questions listed in Chapter III relate to both policy decisions and the implementation of instructional programs. In addition to specific policy issues, this subsection contains those responses that relate both to local institutional mission and instructional focus.

Cory (1984) pointed out that if a district has made a commitment to the implementation of instructional computing, its policy decision will be evidenced in its long-range plans. Ninety percent of all schools responded to the question: "Has your district or school developed its own long-range plan?" Table 16 shows that, on average, half the reporting schools were involved in long-range planning.

Table 16.--Percentage of schools, by community type, citing a long-range plan for instructional computing (N = all schools reporting, 324/361).

	All Schools	Rural	Suburban	Urban
Yes	52.2%	38.7%	63.9%	52.0%
No	47.8	61.3	36.1	48.0

When a school board commits to long-range planning for instructional computing, their policies would be directed toward hardware acquisition, maintenance of technological equipment, procurement of software, and ongoing plans for teacher training and technological updating (Cory, 1984). Table 17 shows responses to the question: "Is there a district-level commitment to ongoing purchases or financial support for hardware, maintenance, software, staff and technological updating? (Please check all that apply)?" Some principals commented that although their districts had made a philosophical and official commitment, the school board or administration had not, in fact, provided financial support. A number of schools, for example, had proceeded individually to provide machines and establish a local curriculum. A commitment of over 75% in most categories of financial support was reported.

Table 17.--District-level commitment to funding policies.

	All Schools	Rural	Suburban	Urban
% of response	92%	99%	85%	89%
Hardware	78	82	83	67
Maintenance	81	77	86	78
Software	84	91	87	71
Staff and tech. updating	76	73	79	75

With a 96% rate across community types, principals perceived the various levels of enthusiasm for instructional computing in their schools. "Enthusiasm" was believed by the experts responding to the study's opinionnaire to be a critical factor in program implementation and one contributing influentially to policy decisions. Principals were asked to identify sources of enthusiasm from the following groups: district-level personnel, teachers, parents, and students. Table 18 indicates the various groups' enthusiasm for school-based instructional computing, as perceived by the responding principals. Enthusiasm across subsets of the school community appeared to be on the high side.

If a district commits to employing a computer consultant, a major policy decision has been put in motion, one that could foster the future integration and implementation of instructional computing across the curriculum. Table 19 shows the principals' responses to the question: "Is there a district computer consultant?"

Table 18.--Principals' perceptions of level of enthusiasm for instructional computing evidenced by various subsets of the school community.

Community Type	Yes	No	Don't Know
District-Level Personnel			
All schools	84%	4%	12%
Rural	89	3	8
Suburban	88	4	8
Urban	73	5	22
Teachers			
All schools	77	12	11
Rural	80	10	10
Suburban	82	10	8
Urban	68	18	14
Parents			
All schools	80	2	18
Rural	75	3	22
Suburban	85	1	14
Urban	81	2	17
Students			
All schools	84	4	12
Rural	89	3	8
Suburban	88	4	8
Urban	73	5	22

Table 19.--Michigan elementary schools surveyed that reported having a district computing consultant.

Community Type	Total Responses: Reporting Schools	Total "Yes" Responses: Schools With Consultant
All schools	353	146
Rural	124	27
Suburban	126	55
Urban	103	64

It is important to remind readers that the present study may include more than one school in a district. Forty-one percent of all Michigan elementary schools reported a district consultant. Becker's (in Chion-Kenney, 1985b) recent national survey of 2,336 public and nonpublic schools estimated that perhaps 1 in 20 (5%) schools has retained a consultant.

The mere presence of a district computing consultant does not guarantee an instructional role. Policy may dictate an acquisition, evaluation, or maintenance role; a staff-development assignment; or responsibilities as an itinerant consultant for all school students and staff. Several schools assigned a consultant only part time to complete the assigned tasks. Of the 146 schools reporting a district computing consultant, 33% of rural, 23% of suburban, and 39% of urban elementary schools reported no on-site or direct assistance from their computing consultants.

Funding for instructional computing programs is acknowledged as a major policy consideration for both the local school and the district. Adoption of an innovation demands resources. In the public sector, a policy decision usually entails diverting fixed resources. Public schools in Michigan are no exception to this reality. Some schools or districts are financially strapped, others are not; some may have the financial means to incorporate the technology but are cautious and reserved in their actions. As a result, microcomputers in elementary schools have been acquired by a variety of means, both traditional and entrepreneurial, depending on the presence, absence, or strength of district policy. The elementary schools surveyed initiated their computer programs sometimes with the direct support of district funding and action plans. But schools also initiated programs "in spite of" district policies that focused on initial implementations at other grade levels or because of other priorities or exigencies.

Schools were requested to respond to the following survey question only if <u>any</u> of their funds for developing the instructional computing programs were secured <u>other</u> than through their local school or district regular funding channels: "Does your building receive any computer-related financial assistance from: (Please check <u>any</u> that apply)?"

Of a possible 361 responses to this special-funding inquiry, 264 schools, or 73%, responded. Table 20 reviews major funding resources used. Some schools reported neither regular school funding nor external governmental funding for instructional computing, but those were few in number. One school, for example, held a special one-time millage for instructional technology. Another mentioned a one-time parent fund-raising effort through which it acquired six computers. Five computers in an urban school were purchased with proceeds from a submarine-sandwich sale. One school's only computer had been donated by a local grocer who saved labels. Parent and community organizations were found to be significantly helpful in terms of technological acquisitions.

Table 20.--Funding sources for educational-computing-related expenditures representing dollars beyond local school or district allocations.

Resource	All Schools		Rural		Suburban		Urban	
	N	%	N	%	N	%	N	%
Percent of those reporting		73%		77%		74%		67%
Chapter I	116	44	44	45	32	33	40	56
Chapter II	108	42	54	58	38	40	16	22
Part B of Educ. Handicapped Act	14	5	3	3	8	8	2	4
Community groups/ businesses	95	36	38	39	42	44	15	21
PTA/parent orgs.	24	9	3	3	9	9	12	17
Other	76	29	24	25	34	35	18	25

Policy considerations also include administrative decisions implemented to update the training of teachers in computer-related areas. Principals were asked to report on the various areas of <u>district</u>-sponsored or funded inservice training. To provide useful answers, the question was posed to help categorize types of training. Listed, in order of frequency reported, were: Introduction to

Computing, Instructional Applications of Microcomputing, Evaluating Instructional Software, Classroom Computer-Managed Instruction, and Programming Languages. The frequency with which specific courses were offered indicated which training categories were perceived by district administration as most to least crucial for all teachers.

Of the 361 schools, 77% or 278 reported that 67% of their faculty had participated in Introduction to Computing inservice sessions; 141 of those schools declared that 100% of their staffs had been trained. Inservices on Instructional Applications of Micros were reported by 178 schools, but only 62 of the schools provided the training for 90% or more of the staff. Inservices on Evaluating Software were offered by 168 schools, with only 40 schools providing it for 90% or more of the staff. Staff training was offered in Classroom-Managed Microcomputer Instruction by 146 schools, but only 39 schools reported reaching 90% or more of the staff. While 120 schools reported offering staff training in Programming Languages, only nine sites included 90% or more of the staff.

District involvement in the support of inservice training is a policy indicator. It portrays the emphasis on student learning through teacher preparation and on a planned integration of computing throughout the K-12 curriculum. It is important to note, as discussed in the Review of Literature, that some schools, because of lack of district funds or unfocused district leadership or because of a desire to get started, have initiated their own inservice training. One school principal, for example, ensured that all teachers would be trained by the resident "expert" computing teacher.

Questions may be raised about how many teachers need computer training and just what training is determined to be appropriate or sufficient (Luehrmann, 1984; Moursund, 1984-85). Discussion aside, it appears from the sampling that most school districts in Michigan believed Introduction to Computing was an essential course for teachers. Also, more than half the elementary schools surveyed offered several courses to at least some staff members.

To determine how firmly entrenched was the district policy to provide instructional computing for students, the following question provided yet another way to gather evidence: "Is there an expectation by middle or junior high school staff that your students will have achieved a specified range of instructional computing experiences?" Table 21 shows that, as yet, only 36% of middle school staffs expect students to arrive with specified computing skills.

Table 21.--Middle school expectation that arriving elementary students have achieved a specified level of computer understanding (rounded to nearest percentage).

	All Schools	Rural	Suburban	Urban
Yes	36%	32%	48%	25%
No	64%	68%	52%	75%

An ancillary question asked if district policies included decisions to use computers administratively or for computer-managed instruction. Ninety-four percent of the surveyed schools responded, and 40% affirmed such uses. About one-fifth of all schools used microcomputers for computer-managed instruction. (See Table 22.)

Table 22.--Percentage of 361 schools using micros for administration and computer-managed instruction.

Community Type	Administrative Uses % Yes	Computer-Managed Instruct. % Yes
Rural	22%	8%
Suburban	39	19
Urban	28	28

Funding for the accumulation of software to match curricular needs is another important policy decision. If a district purchases hardware but not software, there is an absence of understanding about the scope of the commitment necessary to undertake an instructional computing program at all. On the survey form, many principals noted that important sources for software acquisition were parent, teacher, and/or student fund-raising activities.

Principals were asked to report generally the number of pieces of educational software available. (See Table 23.) Nine schools reported no software, and 131 schools reported having 50 or more software packages. Two hundred schools reported more than one but fewer than 50 pieces.

Table 23.--Elementary schools reporting number of pieces of instructional software at the school site (N = 351 of 361 schools) (rounded to nearest percentage).

Pieces of Software	All Schools		Rural		Suburban		Urban	
	N	%	N	%	N	%	N	%
0	9	3%	2	2%	0	0%	7	7%
1-25	104	30	43	36	29	22	34	33
26-49	96	27	38	31	32	25	25	24
50+	131	37	36	30	62	48	33	32
Don't know	11	3	1	1	6	5	4	4

A March 11 letter to the State of Michigan Board of Education from the University of Michigan-Based Training Models for Trainers (TMT) project (1985) reported results of a statewide survey to ascertain what software was being used. The survey achieved at that date only a 12% response rate and was unable to identify numbers of pieces or specific usages.

Two policy questions in the present study related to a school's external liaisons; that is, those that might strengthen programs in educational computing by the pooling of resources or the sharing of information. These related to assistance from the state's intermediate school districts (ISD's) or through formal or informal networking with other schools or agencies.

To find out about the technical or resource assistance available from ISD's, the following question was asked: "Is there an ISD computer consultant regularly available to teachers?" Rural and urban schools reported that only about one-fourth of their schools had access to an ISD consultant. (See Table 24.)

Table 24.--Elementary schools reporting access to an ISD consultant.

Community Type	Schools Reporting N	Schools Reporting %	Yes	No
All schools	337	93%	32%	69%
Rural	122	97	24	76
Suburban	121	94	43	57
Urban	94	87	27	78

The final policy-related question concerned a school's outreach to help and/or receive help with instructional computing from other sources: "Other than Intermediate School Districts, is your school networking or sharing resources to enhance educational computing?" Ninety-eight percent of 361 possible schools responded. (See Table 25.)

Table 25.--Percentage of schools networking educational computing resources.

Community Type	N	Yes	No
All schools reporting	353	30%	70%
Rural	124	19	81
Suburban	125	40	60
Urban	104	31	69

Although networking to share scarce resources was noted as an important engagement for public schools (Eichner, 1984), it has not yet been heavily used as a means of extending local resources. Especially does this appear to be true in rural settings, where only 19% of schools reported developing such linkages.

In summary, the data collected in the statewide survey do provide affirmation for the range of acquisitions and activity present across all community types and also for a prevalent concern for doing something with educational computing deemed appropriate at the elementary level. Evidence of this interest was provided by a written request from almost 80% of the participating principals for a summary of this portion of the study. Also, about 50% of the returns contained voluntarily contributed explanatory written responses that principals appended to the quantitative survey data.

One ancillary question, Number 18, which deals with on-site characteristics that appear to facilitate a high access/high use microcomputing opportunity for most students, is discussed in the context of the six site visitations. Results are briefly synthesized in Table 27 in that subsection.

Six Site Visitations

Conducted after the statewide survey and as a result of evaluating those returns (see Chapter III for description of procedures), six schools were selected for study, two from each community type: rural, suburban, and urban. It was anticipated that descriptions through interviews with teachers, the principal, and a district computing consultant or district administrator might enrich aspects of the quite specific and impersonal quantified survey data.

After the data from the 361 contributing school principals were analyzed, a method was devised to find schools that appeared to provide for a high degree of access and participation opportunities for most students. First, all schools were ranked within their community type by the number of computers, on average, they had dedicated to instructional use of all students. The schools were then evaluated by several criteria, described in Chapter III. A few examples include: If computers were used most of the available time during the school day; if most grades and groups were afforded planned instructional time; and if most students participated in computing education more than 15 minutes per week, these would be indicators of a staff's intention to provide a higher degree of computing opportunities.

Twenty-five percent of all schools in each community type reporting the greatest number of computers in proportion to the student population were identified, for purposes of this study, as high-availability schools; the middle 50%, moderate-availability schools; and the lower 25%, low-availability schools. After arranging the schools by the availability ranking, a variety of _use_ criteria were applied. For example, some schools might report one computer for every 25 students, which might indicate approximately one for every classroom, but when the other data were considered, it was discovered that the computers were idle 75% of the time. These schools would not qualify as high-availability/high-use schools. For purposes of this study, schools were selected for visitation where machines and instructional uses seemed to involve most of the students during most of the available school time. Descriptions of activities at these sites, it seemed, might reveal promising practices.

Grouped by community type, Table 26 shows a range of high, moderate, and low computer availability. Such a method is one way of establishing an estimated range of computer availability for students in Michigan elementary schools. While the figures have limited value, many national data sources rely on similar methods to inform the public about student/computer ratios across states. Over time, the method provides a means to demonstrate annual progress. Market Data Retrieval (1984), for example, estimated that across states there was one computer for every 92.5 students in all suburban schools.

Table 26.--Availability of computers for all students when divided by number of microcomputers, using demarcations of 25/50/25% to group as high, moderate, and low availability (N = 361 schools).

	Computer Availability					
Community Type	High		Moderate		Low	
	Range	N	Range	N	Range	N
Rural (N=126)	5-1/32-1[a]	31	34-1/90-1	64	98-1/584-1	31
Suburban (N=129)	19-1/29-1	32	30-1/72-1	64	75-1/245-1	33
Urban (N=106)	7-1/44-1	25	45-1/177-1	54	177-1/458-1	27

[a]This denotes a range from 5 students for one computer to 32 students for one computer.

Vital information about availability and use emerged when a principal reported that the school's three computers for 300 students were not used because there were no computer-proficient teachers. In the present study, this urban school with a 100:1 ratio would be placed in the moderate-availability category. However, with the computers sitting idle, the ranking would change to moderate availability/low use, in truth, no use because of no access.

The present study focused on school settings and characteristics that indicated a well-implemented and integrated microcomputer program. Such school settings were discovered and described by researchers cited in Chapter II, for example, Sheingold et al. (1983).

The six schools selected for visitation and observation evidenced a particular resourcefulness and vitality in initiating a student-inclusive and curriculum-oriented effort. In addition, they displayed most of the characteristics described below as meeting this study's basic criteria for further study (see Chapter III for the derivation of these characteristics):

1. the presence of strong administrative leadership, participation, and support;
2. basic funding;
3. adherence to needs and ongoing training of staff;
4. enthusiasm by leaders, staff, and students;
5. a plan of action for integrating computers into the curriculum;

6. the provision of appropriate and accessible settings and available times for use, in addition to an adequate number of computers and software to do the job;

7. computer expertise within the local or district staff;

8. school board commitment to the concept and funding; and

9. a broad range of visible applications, with emphasis on applications.

Through the process of sorting and selecting, the six schools emerged as interesting examples for an enriched discussion around the final ancillary research question:

> Research Question 18: In relation to instructional computing opportunities for students, are there distinguishing characteristics locally which appear to foster a climate of high access/participation opportunities for most students?

Several of these characteristics, when considered collectively, appeared to generate the force that locally supported and implemented the innovation of a new technology. In each of the six summaries, a few of these characteristics are described in the context of the school setting, with the intention that a repository of useful insights might evolve. A recent in-depth study undertaken to describe such school implementation and promising computer teaching practices is that of Shavelson et al. (1984).

The framework for discussing each school site includes a description of:

1. The school setting or climate;

2. The status of the computing effort;

   a. funding

   b. number of computers

   c. teacher inservice

   d. student access and participation

   e. range of applications

   f. overall plan

3. The context of the computing effort;

   a. administrative leadership and involvement

   b. assistance of an on-site computing expert

   c. examples of involvement and enthusiasm

   d. school board commitment

4. Summary and the perceived distinguishing characteristics of the educational computing program/process.

All six principals whose schools were visited had responded to the statewide computing survey of elementary schools. They were pleased to have their school be a study site and arranged for appropriate tours and staff release-time. Each visitation was accomplished with a half of one school day. It included observations and an interview with the principal, two teachers, and either a district computing coordinator or central office administrator. For purposes of providing anonymity, the names of the schools have been changed.

Blue Barn Elementary School, Rural

Setting. Blue Barn Elementary, a consolidated school, is located within a farming region. Forty teachers serve a K-4 student population of over 800. A middle school and high school adjoin. While the communities joined by consolidation are chiefly agrarian and low to middle income, a substantial number of residents have ties with the university community some 40 miles distant.

Funding. Funding for the computers followed the approval of a proposal submitted in Spring 1983 to the board and superintendent by a curriculum subcommittee composed of computer enthusiasts and spear-headed by the principal. This grass-roots effort was initiated when resources were especially scarce. The commitment was viewed locally as a major decision.

Numbers of computers. Blue Barn has 12 computers and one computer for administrative use. The ratio of students to computers is 68 to 1.

Teacher inservice. To prepare the teaching staff, a general Introduction to Computing workshop was provided by a team from the ISD. The inservice implementation program includes a requirement that for at least one year each teacher attend the computer laboratory weekly for one-half hour with his/her class. That activity consists of approp-riate instruction and courseware review for both class and teacher. The lab experience is directed by an appointed computing consultant with the title of full-time lab supervisor. Other stated goals for teachers include special sessions to learn more about classroom applications of software, visits to demonstration sites, and, ultimately, training a core of teachers as helpers to other teachers.

Access and participation. The computers are in use nearly 100% of the school day, each student receiving a half-hour of curriculum-related computer time per week. Most of the activity with computers revolves around the computer laboratory experiences; however, five of the lab computers are on carts, which can be reserved for classroom use as well.

Range of applications. Teachers reported using the following applications of computers: mathematics, reading, interactive fiction, language arts, tutorials, drill, problem solving, decision making, and social studies. The computing consultant reported, "The thrust of computer education is to support instruction." Software and experiences are focused on the theme: "The curriculum comes first. In addition, teachers and students will attain a level of proficiency with the computer itself." The content area of science will soon be added to computer applications as the principal works toward a collaborative arrangement with a nearby university to develop an experiential K-4 science program.

Plan. In 1984 a written program was implemented with goals, objectives, time lines, and curriculum-related skill strands for students and desired outcomes across grades. The major goal was: "All students will become aware of computer applications and implications in the world around them and develop skills necessary to communicate with computers and recognize some of the computer's capabilities." The K-4 program will eventually be written and extended to K-12.

Administrative leadership and involvement. Teachers interviewed credited the principal with spearheading the aggressive plan to provide not only a computing program, which included the aforementioned curriculum subcommittee, but also to obtain the services of a local computing expert. The expert is a resident who had previously volunteered time to help preview software, set up the laboratory, and train both interested students and teachers in the nuts and bolts of instructional computing. Based on this satisfactory volunteer arrangement, he was hired to supervise and coordinate the elementary program. The principal, as building leader, assures that teachers are always present with their class in the lab. If teachers have previous computer training, they use lab time for previewing and evaluating new software for their classroom.

The principal predicts that the elementary effort will drive the implementation of educational activity at both the middle and high school, especially when computer-using elementary students matriculate through the system.

Computer expert involvement. The computer expert/lab supervisor presently previews and purchases all software, provides software for teachers to "fit" the curriculum, and helps both students and teachers in the lab each week. He justifies his specified role with a belief that teachers have "little time for software preview" and that many teachers still need both time with computers and software in a supportive environment to acclimate themselves to using the computer as a tool for teaching.

Each summer he provides four week-long computing sessions for students from all grades in the school system. Sign-ups exceed spaces, historically. He hopes to qualify and be appointed the K-12 consultant.

Examples of involvement and enthusiasm. Teachers interviewed were enthusiastic about their school and its potential for improving student achievement. Perhaps because of the K-4 context, more evidence was visible and reported about interventions to assure both successful achievement and improvement of self-concept of these very young children.

The teachers interviewed had mixed feelings about the requirement to accompany their class to the computer lab. One who took several courses at a nearby college said, "I didn't want to learn about this, or any other new thing from anyone else. I'd rather teach it to my colleagues than learn it from them!" She feels knowledgeable enough to select software and manage classroom computer activities. "I would prefer my own classroom computer."

One teacher, who was transferring to another assignment, was interviewed while in the lab. He was using his time to preview software for his new position, while his present class worked with the lab consultant.

Another enthusiastic computing teacher reported frustration with the times when he could have a computer in his class. "It never seems to coincide with the lessons where it would be most applicable.

And the math software we have doesn't necessarily cover the range of students' needs." He said, "I'm sure the school will find solutions to these problems in time."

A teacher of a developmental, multi-age grade told of a personal dislike for computers. "Computers don't turn me on. But the students get good feelings from the feedback they get. They know right away when they get something right; and my kids need to experience success."

District and school board commitment. To emphasize the speed with which the elementary computing program has evolved, at the end of the first 18 months, the principal requested 17 additional computers and fully expects the purchase to be approved. She believes that positive program outcomes will eventually lead to the appointment of a K-12 computing consultant.

Distinguishing characteristics that appeared to promote high access and participation opportunities for students. The principal's support, participation, and leadership were noted as key factors in the evolving computing program at Blue Barn; also the unique laboratory-type teacher inservice required as part of the school day; the availability of an on-site computer-knowledgeable expert; and the staff's enthusiasm for student success. Thus, while there was some dissonance among staff about the lab requirement, they seemed willing to make changes for the sake of providing more options for their students. One teacher said, "We have to try to keep up with technology, even if we are a rural community!"

Snow Sky Elementary School, Rural

In northern Michigan, 150 miles from the nearest university and an hour's drive from the nearest regional ISD, Snow Sky Elementary serves 110 kindergarten through sixth-grade students. One building accommodates all grades K-12. The residents of the surrounding area include both low- and middle-income groups. During the planting and harvest period, the school population swells by 30% as returning migrant families send children there.

The school is a vital hub of community education in the region. It houses a thriving year-around adult education program with its own in-house director. A new K-12 principal, appointed in September 1984, possesses a strong computer education background.

Funding. Computers and computer activity visible at Snow Sky might lead an observer to conclude that the school district spends a substantial amount of money for computers. Although the school board did, in 1982, give official commitment to the concept and funding of an educational computing program, continuing budget cuts and failed mill-ages have all sharply curtailed all but the sustenance spending.

The good supply of computers is present because of an agreement for shared usage informally negotiated between the school administration and the community adult education director and committee. The student population and staff have access to these computers all day and after school. Another few computers were purchased by dedicated funds for Chapter I students and the Education of the Handicapped. In addition, the principal and staff scrupulously examine contingency funds for unused balances. These monies have been used to purchase office computers and instructional software.

Number of computers. For the 110 students, K-6, there are 12 computers usually available. Eight are housed in a laboratory and four, when not being used by specified students, may be rolled on carts to classrooms for teacher/student use. Three computers are furnished for administrative use. One of these will be assigned to the library, where it will be connected with a modem for research, data-base searches, and information storage and retrieval.

Teacher inservice. Before the appointment of the current principal in 1984-85, equipment was in place but not well used. The principal's strong educational computing background and personal enthusiasm accelerated program efforts initiated by a special education teacher and the director of community education. In 1983-84, these two educators helped get approval for program implementation and then volunteered their time to teach interested students and teachers essential computing skills for appropriate teaching/learning situations.

The school district financed an Introduction to Computing and applications workshop at Snow Sky during the summer of 1984. Taught by a university team, the one-week session represented a formal notice to elementary teachers that they were expected to become involved with computers in their teaching. Subsequently, the teachers were encouraged to borrow a computer and software for the rest of the summer.

A third interesting and ongoing inservice component for teachers and students is a volunteer effort, fully endorsed by the principal and led by the special education teacher and two trained aides. The teacher uses her nonscheduled teaching time to teach elementary students and to assist teachers both in the lab and classroom with instructional uses of computers. These three also maintain an open lab after school three times per week.

Comments from teachers interviewed, especially those with apprehensions about meeting the principal's computing expectations, stated that the one-on-one help provided at their request and at their stage of readiness was significant in their growing confidence to use the computer as a teaching tool.

Access and participation. Computers are in use almost 100% of the school day. All elementary students, K-6, spend one-half to one hour per week in guided instruction. Either the computer-proficient aides or the special education/computing consultant teacher provides help. Cross-age groups sign up to work on their assignments or personal projects after school. Peer collaboration during lab time is prevalent.

The principal elected to initiate the K-12 computing thrust with elementary students. And until the teaching staff is visibly more involved and comfortable with computers and software, the principal and consultant believe the supervised lab setting is preferable to a classroom setting for assuring students an equitable delivery of skills and understandings. Because Snow Sky is a small and homey school, the consultant is able to learn what classroom practices can be matched to appropriate software. She selects software for the school, shares it with staff, and uses it with students.

Range of applications. The following applications and languages are used by the consultant and teachers: word processing, LOGO, BASIC, mathematics, language arts, reading, science, social studies, problem solving, decision making, and graphics. Adequate to ample software is on hand. The volunteer consultant also travels to the distant ISD to preview and sometimes borrow software.

Plan. A written plan, districtwide, has not yet evolved, "partly," the principal noted, "because the school is so small and communication is informal; but we will get our plan in writing." Evidence of the plan includes (a) the district commitment to all phases of computer implementation, (b) the reinforcement of staff who are currently active providers of student computing opportunities, (c) the hiring of a computing enthusiast as the principal, and (d) the imminent promotion and staff time-allocation of the volunteer computing consultant/special education teacher.

The principal noted that in such a small school, and in a community with scarce financial resources, raising the level of awareness of staff and community by a visible effort to promote involvement was an essential planning step.

Administrative leadership and involvement. The principal during his first year tried to get a global picture of the K-12 school; he redefined the short- and long-range goals. To emphasize the importance of educational computing, he moved all available computers to a lab setting and targeted the elementary students for the initial training. He also recommended the promotion of the special education teacher to computing consultant. He advanced the expectation that all teachers would become proficient in using computers appropriately in their teaching; provided supportive environments, resource people, comfortable settings, and time to learn; and collaborated to make best use of all resources. Noting that some community members continue to be "outspoken critics of the number of computers in the building, calling it 'extravagant,'" he believes that the open lab in the afternoons and evenings, where community members are welcome, the community education thrust to help residents become computer proficient, and the open houses to show citizens what and how students are learning will diminish the negative commentary.

Computer expert involvement. The volunteer consultant teaches four general and special education classes, one computing class, and uses her planning period and after-school time for teaching, previewing software, and helping teachers match software to curriculum. Her initial positive involvement with computing came from watching her special education students have new successes because of computers. She took coursework in LOGO, educational applications, and BASIC. She reported personal rewards from seeing students become independent users, noting individual progress of teachers, having the support and encouragement of the principal, and experiencing the enthusiastic and expert help of the two computing aides. "But an official appointment would give me more time to do the job right." To motivate teachers she has prepared a plan for the 1985-86 school year. It includes a community-education-sponsored incentive program and, in addition, a "fun course" for all staff using the Applewriter II. The distance from the ISD resources and the absence of an ISD computing consultant impede educational computing progress in rural schools, she noted. "Rural schools have nowhere else to turn."

Examples of involvement and enthusiasm. The Chapter I teacher made constant use of the computers with students. "A common use of computer software for Chapter I students is," he reported, "for reading and mathematics drill and practice." He seldom made use of that option. Rather, he called the computer "a great incentive" for his students, saying, "Students must read to use the computer creatively; then they will make more natural and comfortable transitions to the printed page." In mathematics he did "trouble shooting" by watching the screen as students worked through their story problems. A computing enthusiast, he tried to promote sharing among his colleagues at Snow Sky. "In the small school, teachers could genuinely support each other, but some are still not ready to jump in."

While the Chapter I teacher found the summer inservice very helpful, a primary teacher described it as "too technical." She reported relying on the lab time and the consultant to provide her students with their computer experience. Several of her students she identified as hyperactive and unable to keep their hands off the computer. She could not supervise them and teach, too. Although she had a computer at home, she did not use it. In response to the question, "Should elementary students be provided with computing experience?" she replied, "It's essential for life, and the sooner the better!" She personally needed time to develop familiarity with the keyboard, "without pressure to do something." She thought, at present, her students sensed her "unease."

District and school board commitment. The school board made a decision in 1982-83 to support instructional computing. Because of severe budget problems, expenditures were limited to supporting inservice and consolidating all available human and financial resources toward that goal.

Distinguishing characteristics that appeared to promote high access and participation opportunities for students. An interesting combination of circumstances was present at Snow Sky. Its rural setting undoubtedly, by necessity, strengthened the community education/ adult evening program. In turn, there was a call for the school to be an educational provider of computing for students. The school is the only available agency in the region with the capacity to do so. These necessities created a shared enthusiasm among K-12 and community educators to move ahead, in spite of scarce resources. Maximum access and participation opportunities for students were provided by this sense of mission, creative scheduling, and placement of available computers; in other words, turning "adequate" resources into an "ample" provision.

In addition, there was strong principal participation, leadership, expertise, and support coupled with high expectations for success. "It will take time and patience, but we will move right along." The volunteer computing consultant was an enthusiastic local expert. She had a special sense of how to involve and then bring teachers along at their own pace. Ongoing on-site staff training was provided by the concerted work of the consultant, principal, and two proficient aides.

Sunny Lane Elementary School, Suburban

Setting. Sunny Lane School, in a neighborhood of lower- and middle-income homes, serves a school population of 550 nonminority students in grades K-5. The district has five elementary, three middle, and two high schools. The entire district edges upon an industrial and business area and has experienced dramatically decreasing school enrollments in recent years. Two full-time resource teachers and four 60%-time resource teachers for music, art, speech, and media center join the ranks of 21 classroom teachers.

Funding. In 1979, the school district received a mini-grant to study the question, "Does our district need instructional computing?" The affirmative answer led to a representative subcommittee that developed a literacy program, and the beginning of a phased-in plan for integrating computing into all areas of the K-12 curriculum. A significant policy decision was the means chosen to attain that end: The teaching staff were assigned to the delivery of instruction; this choice rather than training or adding a computing expert to each staff.

The outcome of that decision was funding for basic equipment and software, but chiefly for a substantial and ongoing commitment to teacher inservice, both training and updating. Sunny Lane, itself, has, in addition, an active parent group that has raised funds for needed software.

Numbers of computers. There are 12 computers at Sunny Lane. The ratio is 46 students to one computer. In addition, a single computer is used for both school administration and, heavily, for computer-managed instruction.

Teacher inservice. The principal reported that 100% of the teachers had received district-sponsored inservice in Introduction to Computing and Instructional Applications of Microcomputers; 90%, Managing Computers in the Classroom or Lab; and 50%, Evaluating Instructional Software. He believed that 100% of the faculty were highly or somewhat qualified to teach the district-specified computer-integrated curriculum. A districtwide computing consultant is on call and will visit to help initiate use of new software and to reinforce teachers' efforts or respond to any questions. The principal helps teachers as well. He is a computer "buff" and enthusiast, and one who with other principals, parents, and staff established a grass-roots effort in the district. Monitoring the scheduling and use of computers and assisting teachers are part of his daily routine. These resources combine to delineate a comprehensive inservice effort. The local ISD continues to offer resources, classes, and consultants, as needed.

Access and participation. All students, K-5, are assured 15 minutes to one-half hour of computing time weekly. All subgroups of the school population are included. Fifth graders have more time and use of the two more sophisticated school computers.

Beyond the lab time, teachers may also schedule computers for their classrooms or take classes or groups to the lab. Twelve computer-proficient parents, trained by the principal, offer guidance to students with experiences assigned by the teacher.

Range of applications. Throughout the grade and content areas the following applications of educational computing are used: word processing, tutorials, drill, library skills, LOGO language, mathematics, science, social studies, language arts, reading, problem solving, and decision making. The software available to teachers and students at Sunny Lane has been expanded beyond the district software provision by an active parent group.

Computer-managed instruction involves both students, teachers, and parents. A data-managed reading program provides daily and weekly printouts on student progress. The principal, several teachers, and the school secretary enter the data, which in printout form provides timely feedback to teachers and students and serves as a communicating medium for parent involvement. There is an expectation that all elementary students will have certain computing skills and understandings when they reach the middle school.

Plan. The district made a commitment to K-12 educational computing in 1979. With community and board support, a broad-based subcommittee has provided inservice and related assistance to help teachers deliver the specified curriculum. They appointed their district instructional media director to the new position of coordinator of media services and computing education. The 1984-85 school year was the third year of the elementary school phase-in. In 1985-86 the middle schools will integrate computing through the science program. While the science teachers will be making their first teaching commitment to instructional computing in 1985-86, their students, coming from the elementary schools, will be well-grounded in the uses of instructional software. Already the high school has computers in some traditional areas, but the district plan calls for all students to have a reorientation to computing and at least basic experiences with computers. There is no graduation requirement for computing.

Administrative leadership and involvement. The principal is a visible and active supporter of instructional computing at Sunny Lane. He assists teachers, carefully monitors the scheduling of computers in classrooms and the labs, trains parents to work as aides, promotes parental involvement in purchasing software, features schoolwide activities with students and computing, uses the services of the district computing consultant, and makes the data-based managed reading program an important and involving element of instruction. He pioneered for instructional computing in the district and has high expectations that all teachers will make the best use of computers as a teaching/learning tool. Sunny Lane is a leader among the district's elementary schools in computing. Teachers interviewed hope the principal's retirement in June will not slow the progress being made.

Computer expert involvement. The district coordinator of computing education acknowledged that she is spread too thin to give even adequate help and encouragement to the sizable staff and a student body of 6,000. The gradual program phase-in has helped alleviate some of that pressure, and as more teachers and administrators become computer proficient, a supportive cadre has developed. Her duties include providing for ongoing inservice, assisting teachers, presenting new techniques and information, trouble shooting equipment, coordinating curriculum, and evaluating software. Her media background and networking skills have helped her persist with introducing this new technology to teachers. Many visits to schools and classrooms are necessary. "Teachers must make the transitions at their own time and on their own terms." She reported that most teachers are no longer reluctant to ask for help or clarification of their role in the implementation effort. That, she believes, is her greatest accomplishment.

Examples of involvement and enthusiasm. Believing that one teacher would be representative of all staff, the principal arranged only one interview at Sunny Lane. The teacher, eager to learn about and use computer software with students, said, "The sooner in their school life the better, especially in the area of word processing. Computers are changing the ways students can learn; also in cooperative learning activities and in raising self-esteem." She entered into self-teaching activities to gain experience. For example, she helped initiate the reading-management system. She relied heavily on the help of a school parent, a corporate computing consultant, for help and advice.

Her overall enthusiasm for educational computing and its benefits for students were dampened by personal and professional frustrations, including time. She believed that having to use the volunteer help provided meant more planning for her, and that teaching all objectives for all the grade levels in her multi-age class was overwhelming. She objected to administrators' attending the major computing conferences, while teachers are responsible for understanding and implementing programs in the classroom. "Most often the district inservices are off target with what's needed. "It's like 'teach the kids, but don't teach me!'"

To help students explore computing and become self-motivated users, she prepared many lessons and previewed software at home. This necessity, she complained, infringed on her personal and family time and caused more limited preparation in other content areas.

District and school board commitment. Since 1979 the board and a broadly representational district instructional planning committee have endorsed, helped revise, and monitored the implementation of K-12 educational computing. Many decisions entail negotiations between labor and management.

Distinguishing characteristics that appear to promote high access and participation opportunities for students. Although funding for computers and peripherals is low, reducing the number of computers for students to almost less than adequate, the continuing board and administration support for inservice and its high expectation for K-12 integration partially overcame the limitations. They have demonstrated six years of continuing financial support and have continued employment of an enthusiastic and involved computing coordinator to assure that the job gets done.

The principal's involvement and leadership help to make Sunny Lane School one with exemplary teacher/pupil/parent involvement. It is the only district school with a parent-aide cadre. Another outstanding characteristic is found in the board decision to implement K-12 computing through a policy of ongoing teacher inservice with the expectation that all teachers will become computer proficient in teaching the specified curriculum.

Green Vista Elementary School,
Suburban

Setting. Green Vista Elementary School lies in a peaceful suburban community near a large city and a university. It is one of three elementary schools serving kindergarten through fifth grade and is part of a district with one middle and one high school.

Funding. Computing-related expenditures have been a district-wide school board commitment since 1984. In addition, Green Vista uses contingency fund ending balances and initiates fund-raising activities to purchase needed curriculum-matched software. An aggressive search for funds for equipment and software led the principal to help write a proposal for a possible State Department of Education allocation.

Numbers of computers. There are 14 computers for student use, making a ratio of 25 students to one computer. One computer is used for school administration. The computers, on carts for portability, are used primarily in a laboratory situation; however, some are always available for classrooms.

Teacher inservice. A K-8 computing consultant plans and arranges varied inservice activities, designed eventually to train all district staff, beginning with elementary teachers. The second training phase will include administrators. Training is planned to progress from introductory to specific. In fall 1984, a massive training schedule initially familiarized all teachers with the newly purchased computers and district-approved courseware.

Orientation training was followed with on-site, in-class assistance from the computing consultant during October and November. In December, Green Vista's computing-proficient principal, the consultant, and two computing experts from the ISD offered an inservice workshop on evaluating grade-level courseware, which would be used immediately by teachers with classes. The consultant worked directly over the next few months with all teachers, including Chapter I and teachers of the gifted.

Nine parents were trained to help teachers and students in kindergarten and first grade. Computers may be checked out by teachers over any vacation break. Seventy percent of computers are reported in use on nonschool days.

The goal of teacher inservice is to integrate the computer into the overall curriculum, both through classroom use and use in the computer center or lab. The anticipated outcome will, as a by-product, produce teacher and student computer users.

Access and participation. Computers at Green Vista are used between 76% and 100% of the school day. All K-5 students, in addition to a pre-primary special education and EMI class, have computer time. Because the computing consultant shares time with all elementary schools, the principal is an active and ever-present source of help to teachers, who in most instances are learning to use certain pieces of courseware along with their students. Computers are available for use during lunch break and after school. There is an expectation at the middle school that all matriculating elementary students will have learned a specified range of computing experiences.

Range of applications. The following applications are used by students throughout Green Vista: word processing, simulation, LOGO language and applications, mathematics, language arts, music and art, social studies, problem solving, and decision making. Two decisions by the district will have an effect on curriculum in 1985-86: A K-8 curriculum team has developed lessons and related software for social studies and language arts; also, a data-management system has been purchased for reading.

Plan. Green Vista is part of a district with a detailed instructional plan for integrating computers into the curriculum. There are timelines developed through 1989. Already the K-8 curriculum team is "revising and restructuring" the initial plan, based on progress made and new knowledge of better ways to proceed. Beyond the inservice for teachers and classroom and lab work with students, the computing consultant reported progress in meeting those timelines. In spite of tight district timelines and high expectations for meeting them, time and space are built in for teachers to acclimate to computers, use software, and manage class instruction. The consultant reported, "We seem to be making progress in getting teachers to use the computers both in their classroom and in the center. More names are appearing on the sign-up lists; if I had more time for helping them, it would move faster."

Administrative leadership and involvement. The principal of Green Vista School, new to the school but not to the district, is a former teacher who was instrumental in initiating instructional computing in the district. A computer user, frustrated by the absence of computers for student use, he and others presented evidence to the superintendent and board to help explain the importance of computers as teaching/learning tools. Supportive of the need for and role of an on-site computing consultant whose only job is "helping students and teachers," he said, "Her time should be protected, to that end; and lack of money is not necessarily a drawback. It helps us work together to find creative ways to help something important happen for students."

Computer expert involvement. The K-8 computer coordinator was appointed to consult and help teachers and students K-8 in 1984-85. Her position, funded at 60%, includes training of district staff, review and purchase of all software, presentation of programs and materials to classrooms, consulting with staff on computer applications, and developing a comprehensive K-8 curriculum. Her monthly reports and progress log indicate that the district goals and her individual goals have proceeded well. In the 1985-86 year, her position will be full time.

Examples of involvement and enthusiasm. The principal and computing consultant both expressed a commitment to helping teachers and students become computer users. By the same token, they stressed the need to allow for differences in time needed by individuals to adapt and to develop a motivation for trying something new. "I want teachers to own the project." The staff evidenced enthusiasm for school and students. The atmosphere was positive, cheerful, yet academically oriented.

The two teachers interviewed believed educational computing for elementary students was "highly important." One teacher had been a personal-computer user for four years, had taken classes and read computing journals. She used computers as soon as they arrived at Green Vista. The former principal assigned her the task of reviewing and selecting software. The teacher called the inservices and the consultant's help "right on target."

The other teacher interviewed said, "I would be helped more by inservices at a slower pace, and in layperson's language. Massive inservice sessions "are intimidating." She was looking forward to taking a computer home for the summer, so that she would be as "proficient as her students." Both teachers were enthusiastic about computing. One felt held back; the other, rushed.

District and school board commitment. There is a long-term financial and philosophical commitment to educational computing in the system. Because funding is not ample and computing is only one priority, the program will be closely monitored and evaluated. "We recognize the need for ongoing staff training and the value of offering computer education for parents and community. We realize that the rapid advancement in computer technology requires planned evaluation and revision of curriculum, hardware and software," the board and administration stated.

Distinguishing characteristics that appeared to promote high access and participation opportunities for students. Green Vista school contained, in some degree, almost all the facilitating characteristics that experts in this study determined might facilitate a high degree of student access and participation, including an adequate number of computers and adequate funding. The most overarchingly influential elements at the local school were the principal and computing consultant's participation, involvement, and support, which helped generate an observable level of enthusiasm by both teachers and students. Important, too, was the school board's commitment to the district plan for computing.

Cityside Elementary School, Urban

Setting. Cityside Elementary is one of 50 elementary schools in the system. With 275 students and a large minority population of bilingual students, it is located in a pleasant neighborhood of moderate-income homes and is constructed in pod areas for team teaching.

Funding. There is no computer allocation for hardware. All computers were purchased with money derived from the sale of submarine sandwiches. The parent group has actively supported this project, initiated by a computer-enthusiastic teacher. A district commitment to educational computing is under consideration, and during the present study a computing coordinator position and a K-12 implementation were being approved. It is important to note that Cityside has proceeded as a school to implement its program and obtain software.

Numbers of computers. The school has accumulated seven computers, which reside in a laboratory. The open pod arrangement makes the lab accessible to most classes. The ratio of students to computers is 39:1. In the K-6 school, grades 2 through 6 receive formal instruction and computing time. The computers are on carts.

Teacher inservice. A districtwide inservice in 1982-83 on the Introduction to Computing, and free inservices provided by district and area collaborating educational agencies, have given teachers an opportunity to gain computing-related knowledge on a voluntary basis. Cityside is an exception in having generated funds to obtain computers. Most of the other elementary schools do not have them. The seven computers are used for local inservice and student applications. Most teachers in the building are at a "comfort" level or higher with their use of computing with their students. A computer-enthusiast teacher, because of the team teaching situation, has been able to help many more teachers and students than if the school had a traditional classroom setting. A special education teachers' workshop inspired another building teacher to enhance her students' learning through computing. These two teachers and a developing cadre of computer-proficient students have constituted the "inservice" thrust. That is, local teachers and students have helped each other attain competency with the machine and familiarity with software.

The basis for this locally generated effort to provide both computers and laboratory opportunities for both students and teachers is justified by the principal as "the urgent need to provide 'hands-on experience' for all students, at the very least!"

Access and participation. While most of the available software has been purchased with fund raising by parents, some was acquired through public-domain sources. A central office administrator with broad media responsibilities initiated use of this resource. There are over 50 pieces of instructional software. The computers are used between 76% and 100% of the school day, in addition to before school, during lunch break, and after school. They may be checked out on weekends for home use. They are used equally by all classes, grades 2 through 6, including special education and the gifted, in a time range of between one-half and one hour per week. The principal helps supervise the labs. The principal credits each year's sixth-grade class with acting as the resident "tutors."

Range of applications. Cityside's principal and staff pressed for early accumulation of computers and software to assure their students an awareness of and experience with existing technology. While they did not want to usurp district responsibility, they knew that district implementation might be some years away. Therefore, the range of applications is based on available and borrowed software. Applications include tutorials, drill, mathematics, reading, problem solving, language arts, science, decision making, and spelling.

Plan. A district plan is emerging as this current study concludes. A district supervisor for computer education was appointed in early 1985. Even with numerous other district responsibilities, the consultant has moved with a committee to draft a K-8 curriculum and a K-12 plan, including Introduction to Computers for ninth or tenth graders who have matriculated through the system before the district purchase of computers for district schools. As part of the plan, a staff volunteer will be appointed as computer resource person in each elementary school. The long-range goal is a computer in each classroom; this will be preceded by a semi-lab situation. During the first year of implementation, there will be a lab in each middle school, two pilots for special education rooms, and one pilot for bilingual education classes. Cityside School will receive software from the district under the new plan, but because of its early successful efforts through local fund raising to provide computers, it will not be eligible for district-purchased computers.

Administrative leadership and involvement. The principal at Cityside School promoted instructional computing by facilitating the work of the local enthusiasts and experts and by finding ways to nurture faculty acceptance and involvement and student participation. Parents are actively encouraged to participate in all phases of the instructional and social programs of the school. The principal set up an exchange program with another city school that has no computers. It gave her students and staff a chance to share their knowledge and facilities, reinforcing their efforts, while providing an encouraging model for eventual district implementation.

Computer expert involvement. The recent appointment of a central office administrator as coordinator of educational computing was followed by a series of visitations to other school districts and national workshops by the coordinator and a districtwide committee. At the time of the school-site study, Cityside Elementary School had only a resident expert to foster educational computing. That teacher and another supportive central office administrator were the influential and visible components of the computer education program at Cityside.

Examples of involvement and enthusiasm. The kindergarten teacher interviewed was eager that additional equipment and software be provided so that appropriate computing experiences could be extended to grade 1 and kindergarten. Convinced that educational computing "is a priority for elementary students," she spoke of being "eager" to be involved in training that would accelerate her participation.

The teacher who initiated computing in the school and helped other teachers learn pointed to the involvement of students in the teaching of others as significant and a boost to school pride. She developed a plan for nonusers to be partners with users until all were comfortable with the machine. As a result, even though almost 50% of Cityside's students are bilingual, all students in her team-teaching area are computer users, and those observed were enthusiastic.

District and school board commitment. The recent board decision to fund and implement a K-12 computer program, including inservice, the acquisition and maintenance of hardware and software, and the appointment of a computing consultant, indicates a long-term commitment to computer education for all students.

Distinguishing characteristics that appeared to promote high access and participation opportunities for students. The outstanding characteristics at Cityside School were fully described in preceding sections and include principal's involvement, participation, and support, a local computer leader who delivers locally based inservice, and enthusiasm for computers by local leaders, teachers, and especially students. Students at Cityside were especially involved. Their sharing attitude, successes, and academic achievements were showcased in this school.

Metro Lake Elementary School, Urban

Setting. Metro Lake Elementary School is one of ten elementary schools in an urban district with two high schools and four middle schools. Surrounded by the neighborhood's middle- and upper-middle-income residences, it borders on a business, high-technology, and industrial region. There are 175 students in grades K-5.

Funding. In addition to strong funding support from the district, educational computing has been supported by local community groups, by Part B of the Educational Handicapped Act, PL 42-142. The computer effort began with a grass-roots push from local teacher/administrator computer enthusiasts and the demand from a computer-aware community. The district, early on, made a commitment to fund and support computer education K-12.

Numbers of computers. The ratio of students to computers is 28:1. There are six computers at Metro Lake for student use. No computer is yet available for computer-managed instruction or school administration.

Teacher inservice. Two important components influence teacher inservice at Metro Lake: a districtwide teacher consultant for instructional computing and a training component that has prepared each school media specialist as the on-site resource person for staff and students. The implementation of educational computing depends on a combination of trained personnel, networking out to train others so that eventually every teacher will be responsible for using the technology to complement all areas of the curriculum. The district expectation is that the instructional program will integrate computers as a tool of learners, rather than as an appendage to the instructional plan.

The district computing consultant also trains parents, who then act as guides in the elementary and middle school labs. With this kind of reinforcement, the principal noted only one drawback--some teachers were not motivated or yet willing to be computer users. While 100% of the students use computers once a week, only about 25% of the teachers do. With the local media specialist always near the lab to assist students and teachers and provide software, with trained parent aides, and a district computing consultant on call, teachers in a few instances have not felt called on to become hands-on users. Because the district plan calls for a fully curriculum-integrated computing program, the next phase of inservice will be focused on helping teachers develop a comfort level with both machines and new software. The computing consultant will take curriculum-related software to schools and work with small groups of teachers on something directly related to their lessons. This progression of inservice protocol is in its sixth year. The districtwide orientation inservices, so valuable in the early years, the consultant reported, are being replaced by activities that accommodate local schools' and individual teachers' needs.

Access and participation. All students at Metro Lake use the computer at least 15 minutes to one-half hour per week. The computers are in use 76% to 100% of the school day and are also available during lunch hour.

Six computers are in a lab adjacent to the media center. The special education classes have their own classroom computers. Additional software, to extend activities for students, has been purchased with money raised through fund-raising activities by both parents and local merchants.

Range of applications. All students are experienced in the following applications by the time they complete grade 5: word processing, simulation, library skills/data-base searches, LOGO, mathematics, reading, language arts, science, music, art, social studies, problem solving, and decision-making skills. In addition, the editing and publishing of stories for book-making projects, data management for special education students' progress, and editing and publishing the school newsletter are uses of computing at Metro Lake. All local uses are influenced by the district's expectation that computers will be integrated into every area of the curriculum.

Plan. The district plan was developed with encouragement and assistance from teachers, administrators, and community. A preadoption planning and development phase began in 1981. A districtwide committee of parents, community, and business representatives, teachers, and administrators set a timeline and agenda in 1983. The K-12 curriculum, reviewed and adjusted on a planned cycle, automatically accommodated the new technology plans. A K-12 integration was preferred to teaching computing as a separate subject; however, in the first years of the plan a computer-literacy component was necessary to ensure all students acquired the basic skill and knowledge base to use and understand computers.

Administrative leadership and involvement. The principal, in addition to the computing expert/media specialist, district instructional-computing coordinator, and a cadre of parent assistants, provides strong leadership in encouraging teachers to take hold of computing as a tool for teaching. She arranges for substitutes and frequently serves as a classroom substitute so that teachers may work with computers and courseware, visit project sites, or attend inservices. She collaborates with the district computing consultant to find new ways to involve teachers in the process. She asserted, "The district implementation plan is only 'token' until teachers commit themselves to educational computing."

Computer expert involvement. The district teacher consultant for instructional computing and Metro Lake's media specialist are active and helpful computing enthusiasts. The district consultant's job targets include a responsibility for the "planning, coordination, and utilization of computers in the K-12 instructional program." One of the major roles of the consultant is introducing new courseware to teachers.

> It is at that level that an intervention makes logical sense to busy classroom teachers. They can see how the computer helps students "conceptualize" in ways that other teaching methods cannot. When a teacher can see, through demonstration, that the computer is not just another "add-on," but is actually helpful within, for example, the context of a daily lesson on mathematics or creative writing, the teacher will put the computer to use.

Examples of involvement and enthusiasm. The two teachers interviewed at Metro Lake were representative of each end of the enthusiasm spectrum. One teacher doubted that it was essential to introduce computers in elementary school at all, and if it was, "the consultant could do it." The other teacher helped both students and other teachers to learn. Parent, administrator, and student enthusiasm, in addition to district enthusiasm, was strong and evident. Broad applications were visible.

District and school board commitment. Not only was the long-range commitment made to educational computing but to all new technology. The five-year curriculum cycle in the district revolves again to educational computing in 1985-86. The program will be thoroughly monitored, evaluated, and adjusted. The district is a leader in the development of a computing curriculum and has shared its expertise and findings with other districts (Bancroft, 1983a). All students are guaranteed by the district a comprehensive education in new technology.

Distinguishing characteristics that appeared to promote high access and participation opportunities for students. Metro Lake School has an encouraging climate for students and teachers alike. The principal's instructional leadership and commitment to the students' full opportunity to learn creates an imperative for all teachers to use all possible tools to promote this end. The district and school board commitment to educational computing and their funding of it are significant.

Promoting a high level of access and participation for Metro Lake is the district computing consultant, who verbalized a commitment to help individuals and groups at their own level of readiness, but always with the expectation that they will move forward meaningfully. In concert with the local computing expert/media specialist, the two provide a unique, ongoing inservice component.

<u>Summaries of Interest From the Results of Interviews With Principals, Teachers, and Computing Consultants at the Six School Sites Visited</u>

<u>Principals</u>. Three principals were what Becker (1984a) called "computerists," having been early computer users, and eagerly seeking ways to translate the potential of the tool into classrooms. The other three used computers, but not as computer "buffs." However, all six were involved in efforts to insure district-level attention to computer integration, had high expectations that teachers would all participate in teaching the intended curriculum, monitored the implementation, and were visible in assuring the importance of the computer as a tool to incorporate in planned learning experiences. They instigated or collaborated with local teacher "buffs" and parents to acquire the physical components needed to provide broad access and participation opportunities.

<u>Teachers</u>. Two teachers were interviewed at each site except at one school, where the principal believed one teacher would represent all points of view. Time was limited. Most interviews were conducted while the principal supervised the teachers' classes or during their planning time. Although a structured interview form was used as a guide, it proved more efficient to ask only the role-specific questions because answers to more general questions were extractable from other sources.

All 11 teachers agreed that incorporating educational computing at the elementary level is important or essential and that middle or high school is "too late." Some were avid computer users; others had varying degrees of experience and comfort levels with computers.

None had been undergraduates when microcomputers were introduced into college education curricula, but they were eager to recommend components for preservice teacher training in instructional computing, such as hands-on computing experience, at least simple programming, courseware applications in undergraduate content-area classes and in a "computers in education" environment, and a requirement that all preservice teachers actually work with children, computers, and software in a simulated classroom environment.

Their recommendations for inservice training included fewer immersion courses, such as Introduction to Computing, and more on-site, one-on-one assistance with applications. If inservice could be offered in small-group settings, they preferred that their co-learners be from similar grade levels or content-level groups and that they have about the same degree of computer proficiency. Masny characterized the larger district inservices as "off target." A Chapter I teacher believed that "teachers should share more with other teachers and with students and should not be afraid to be <u>uninformed</u> on their way to becoming <u>informed</u> about educational computing. Students need to see their teachers involved" (emphasis added).

Oft-repeated suggestions for teacher involvement and participation were: (a) time to learn the keyboard, explore software, and match curriculum to courseware, with support when needed from a computer-educator specialist; and (b) an opportunity to develop at one's own stage of readiness. Many felt forced into a role before they were technologically, intellectually, or emotionally prepared. Others complained of group training where those teachers who have some experience dominate the learning environment. Some teachers saw the computer as a tool, others as "just one more thing to do." A few teachers complained that too few computers made integrating computers into activities neither feasible nor efficient.

Computing consultants. In all six schools visited, a district consultant was acknowledged. To clarify, two were official K-12 computing consultants with backgrounds as media specialists; they were appointed when the district implemented a K-12 curriculum-integrated program. Another was a K-8 consultant, former teacher, and computing enthusiast who was hired for six-tenths time but subsequently recommended for full time and K-12. The fourth was a special education/ general education teacher who taught a computer class and volunteered all extra time to helping teachers and students. Hoping for an official appointment, she was recognized by the district as the unofficial consultant and spokesperson for all computing matters. Another was a volunteer and computer expert who was hired to supervise the elementary laboratory. He hoped for an eventual K-12 assignment. The sixth consultant interviewed was appointed K-12 consultant after the local school in his district was selected for study. That school's resident consultant was a computer-using teacher enthusiast. The district consultant's new role was as an add-on with numerous other districtwide responsibilities.

In years, consultancy assignments represented two with four or more years, three with about one and one-half years, and one with only a few months.

Role-specific responses of interest were the following: All six stated that teachers eventually must be active participants in the delivery of student instruction in the context of appropriate software presented at the appropriate content-and-learners' "moment in time." They saw this as a gradual process, and one in which the consultant's role was that of help, encouragement, and providing appropriate software, classroom-management techniques, and one-on-one help when needed. Two stated that they were spread too thin to do this job adequately. Funding for ample machines, courseware, and especially released time for teachers to explore the new technology was an essential requirement. All received their training in various ways: self-teaching, keeping up with the literature and research, taking classes of interest, and attending educational-computing conferences and workshops. None was degreed specifically to teach computing.

A veteran in the role of district computing teacher/consultant summarized: "It is important to put computers in the context of what teachers are teaching and students are learning everyday." In citing the prevalence of teacher anxiety about using computers with students, she said, "Think of the elementary teachers who teach six subjects! How can computers help them do _that_? Then, show them software that _will_, and give them time and space to make the transition."

Her rationale for helping teachers learn to use computers with students was: "Students can learn by 'watching teachers be students.' The teacher and computer together can move students toward conceptualizing. There are, as yet, so few teachers who can help students to do that; and yet, that's what teaching is all about."

In summary, the six school sites visited provided a rich base for study. To summarize the demographics of these six schools briefly, Tables 27 and 28 are provided. The combination of characteristics that appeared to help drive the progress of these schools in providing high access and participation educational computing opportunities for students have been restated in the tables but are, in fact, most clearly apparent within the sections containing the site summaries for each school.

Table 27.--Selected summary data from six school sites visited, May 1985.[a]

Site, Setting, Approx. Population	1983 State Ranking Per Pupil/Inst. Expenditures	Locally Identified Characteristics That Have Helped Facilitate Innovation of Computing (Other Than Funding)	ACCOUNTABILITY					FUNDING SOURCES: How Most Computers Acquired (M=most, S=some)						
			Dist. Plan?	Written?	Local Plan?	Written?	Date Imple-mented	Local	Dist.	Ch1	Ch2	Art3	SPED	Comm./ Parents
Blue Barn Rural 800+	453	Principal leadership, support, involvement Computer expert on site and assigned Teacher inservice on site High enthusiasm within school	No	No	Yes	Yes	83-84		M	S			S	S
Snow Sky Rural 110	166	Principal leadership, support, involvement Enthusiastic local expert/ volunteer consultant Ongoing teacher inservice, on-site Creative use/time sharing= ample computers	No	No	Yes	No	83-84	M		S			S	
Sunny Lane Suburban 550	23	Principal leadership, support, involvement Board/administration commitment Ongoing teacher inservice Enthusiastic district consultant	Yes	Yes	Yes	Yes	82-83		M				S	S
Green Vista Suburban 350	79	Principal leadership, support, involvement Board/administration commitment Locally enthusiastic computing consultant High enthusiasm on site	Yes	Yes	Yes	Yes	84-85		M	S			S	S
Ctiyside Urban 175	171	Principal leadership, support, involvement Local computer teacher Local teacher inservice Local enthusiasm	Yes '85	No	Yes	Yes	82-83						S	M
Metro Lake Urban 175	2	Principal leadership, support, involvement District computing consultant, enthusiast Locally enthusiastic computer expert District commitment to concept/ plan	Yes	Yes	Yes	Yes	82-83		M				S	S

[a]Data related to ancillary Research Question 1B.

Table 28.--Selected data from six school site visitations, May 1985.

Site	Location of Innovation Advocates		Innovation History D=district L=local	Number of Computers	Ratio	Time Micros Used/ School Day	Used Weekly by Every Student	Grades in School: Grades w/ Access	Used Outside Regular School Day?
	Early	Later							
Blue Barn	Principal A few teachers Volunteer computer consultant	District	D=low L=high	12	68:1	75-100%	1/2 to 1 hour	K-4 K-4	Yes
Snow Sky	Comm. ed. director Spec. ed. teacher Ch. 1 teacher	Principal	D=low	10+	10:1	75-100%	1/2 to 1 hour	K-6 K-6	Yes
Sunny Lane	Principal Cadre of district and community early adopters	District	D=mod. L=high	12	46:1	75-100%	15 to 30 min.	K-5 K-5	Yes
Green Vista	Cadre of district early adopters	District	D=high L=high	14	25:1	75-100%	1/2 to 1 hour; varies by grade	K-5 K-5	Yes
Cityside	Local teacher Local principal	District '85	D=low L=high	7	39:1	75-100%	1/2 to 1 hour; varies	K-6 2-6	Yes
Metro Lake	Local school Community early adopters	District	D=high L=low	6	28:1	75-100%	15 to 30 min.	K-5 K-5	Yes

Table 28.--Continued.

Site	Pieces of Software	Middle School/ Junior High Staff Expects Elem. Students to Have Skills	Who Is Responsible for Instruction?[a]	Broad Range of Appli- cations	Intention to Obtain in 85-86: (H=hardware) (S=software) (I=inservice) H	S	I	Adminis. Use of Computers	CMI	Computer Location (*Primary)
		Instruction and Future Implementation Prospects								
Blue Barn	50+	No	Consultant	Broad	Y	Y	Y	Y	N	Lab*+cart
Snow Sky	50+	No	Consultant	Broad	Y	Y	Y	Y '86	N	Lab*+cart
Sunny Lane	50+	Yes	Teacher	Broad	N	Y	Y	Y	Y	Lab*+cart
Green Vista	50+	Yes	Consultant	Broad	Y	Y	Y	Y	N	Lab*+cart
Cityside	50+	No	Teacher	Moderate	N	Y	Y	N	N	Lab*+cart
Metro Lake	50+	Yes	Media specialist	Broad	Y	Y	Y	N	N	Media center+ cart

[a]All schools are working toward teacher as chief deliverer of instruction.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS FOR RESEARCH AND PRACTICE, AND REFLECTIONS

Chapter V reviews selected findings from both the statewide microcomputing survey of 600 elementary schools and the on-site staff interviews and observations at six high-student-access and high-student-participation school sites. It is arranged in the following manner: summaries, conclusions, recommendations for research and for practice, and finally, reflections on the study.

The purpose of the study was to collect, from a sample of Michigan rural, suburban, and urban public elementary schools, data to help describe selected policies and educational practices pertaining to local availability of microcomputers, their access to students, and the specific instructional uses most prevalent. The data were further analyzed to locate and describe a few of the schools where a high degree of student educational computing activity was reported. It was anticipated these selected schools, if visited and observed, might reveal a number of characteristics in their policies, practices, or cultural context that appeared to contribute to a climate of high access and participation opportunities for all students.

It is important to reemphasize that the purpose of this study was in all cases to provide an across-community-type representation of effort, to note the progress of the effort, and, through a few site reports, to characterize it. Neither identifying comparative wealth nor community type per se was a specific interest to the outcomes of this study. As Howe (1984b) remarked, "Money makes a difference; . . . stop studying the obvious" (p. 14). Rather, it was of interest to determine how Michigan elementary schools are addressing the educational uses of a new technology and to characterize the nature and substance of the local efforts.

Chapter I established the need for reviewing the status of educational computing policies and practices in Michigan public elementary schools, described the plan and format, and defined the specific purpose of the study.

Chapter II reviewed selected relevant literature in the following topical areas: (a) Society, Technology, and Calls for Change; (b) an Overview of the Integration and Implementation of Instructional Computing Programs; (c) a Discussion of Selected Topics Related to Microcomputers and Student Learning; (d) Policy Considerations Confronted by Educational Planners; and (e) a Brief Overview of the Arrival of Microcomputers and the Implementation of Educational Computing in Michigan Public Schools.

Chapter III presented the methods and procedures for the study and described the population sampled and the instruments used to gather data statewide and at elementary school sites. Chapter IV provided analyses of selected data collected from both the statewide survey related to the status of educational computing in Michigan elementary schools and the descriptions of related activities at six school sites.

Summaries

Selected findings from responses to the four major research questions contain, when appropriate, selected observations from the six site visitations.

The Statewide Survey

> Research Question 1: What is the representative level of integration of microcomputers dedicated to educational usage in a sample of Michigan public elementary schools?

While the question calls for a quantitative answer, the aggregate response to it offers a current perspective on the priorities Michigan educators have for the acquisition of microcomputers as one new technology. If 361 elementary schools report 2,750 (on average, almost eight per school) micros for student use and microcomputers only began to be "kid proof" and adaptable for desk-top and school use in about 1980, then the data collected for this study in early 1985 confirm a measurable school effort to provide hardware. In addition, 63% of all schools also reported 26 or more pieces of software.

The data indicate that across schools there was a ratio of 81 students to every one computer. However, the range of students to one computer across all schools varied dramatically, from as few as five students to one computer to as many as 584 students to one computer.

Research Question 2. What can be described as the level of instructional computing access and participation opportunities for students across grades and groups?

It is all too apparent that student-to-computer ratios mean little without information to corroborate their full use and distribution across subsets of the population. Answers to this question give some indication of how a local school, with either few or abundant human or material resources, provides a planned experience on a regular basis for students. What could not be readily depicted in tabular form was the seemingly endless variety of grade combinations and wide-ranging student use-time allotments reported by individual schools. For example, one of the schools visited allotted 30 minutes per week to second grade, 40 minutes to third, 60 minutes to fourth, and 45 minutes to fifth and sixth.

The study indicates that 73% of all schools surveyed reported planned instruction. And 97% of those with an instructional plan for computing chose to emphasize and provide instructional computing in the third-to-fifth-grade range.

Aside from whether or not schools offered "planned" instruction, principals were asked how many students spent time on a computer once a week. Fifty percent or more of all students in 50% of the 361-school sample were provided with 15 minutes or more computing time per week; 60% of those schools assured that the use-time was equal across similar grade sections. While only half the schools surveyed offered at least 50% of their students 15 minutes or more computing time per week, many other schools did, in fact, report offering assured computing time on a predetermined schedule to a representative percentage of students. Again, the extreme variety of reported data did not lend itself to informative tabulation for presentation. A few examples from principals' comments will help clarify student use-time: "Computer time is rationed so that each classroom can plan on having all the school computers available for two weeks each school year." Or "Our fifth graders have two months of planned computer-related activity." Or "Only Chapter I students in our school use computers, and they use them at least two hours per week."

A number of schools reported that some of their computers were used only by certain groups of students. Of 303 schools reporting (84% of all schools), 66% reported that some of their computers served special education students, 64% that certain of their computers served Chapter I students, and 56% reported computers especially purchased and reserved for gifted classrooms. Only a small percentage of respondents made written comments to address just how many of their computers were designated solely for the use of these students.

The data indicated that in all 361 schools, 41% used their available computers less than one-fourth of the school day. Only 19% of the schools used their computers between 76% and 100% of the available time. Becker's (in Chion-Kenney, 1985) recent study of computers in schools acknowledged this machine-usage discrepancy but reported an increase in overall use from previous years. Machines could be idle for a number of reasons discussed elsewhere. What is important for planners to note is that a capacity for greater use of present machines is possible.

In regard to access, the placement of computers, regardless of their abundance or scarcity at a particular school site, appeared to require a blend of alternatives. Fifty-five percent of all schools located their computers in more than one location. Placing them on carts for mobility was also important. In the six school sites visited, where high access/participation opportunities were one criterion, the computers were in a laboratory, not a classroom setting, but some were on carts available for teacher checkout. The labs were supervised in the following ways: The teacher and class had a scheduled time; the students were taught and/or supervised by a computing aide, a media specialist, a trained consultant, a computer-proficient principal, a volunteer teacher, or sometimes a trained volunteer. Not infrequently, an adjunct to this supervision was students helping other students, both spontaneously and through assignment.

Additional access to computers was provided for students before school, at lunch break, or after school by 54% of all rural, 50% of all suburban, and 30% of all urban schools. A number of schools reported lending computers to families and teachers on the weekend and over vacation breaks.

Equitable access to computing opportunities across similar grade sections receiving planned instruction was assured by 68% of the reporting schools. Equity of access across groups was not as readily discernible. Local decisions influenced which grades were provided with computing time and for how long. Twenty-four schools informally added the comment that their only computers had been purchased with designated funds and therefore could be used only by designated user groups.

<u>Research Question 3</u>. What educational applications of microcomputers are most generally present for students?

What ought to be going on in schools due to the fact that there is computer capability has not been ascertained (ASCD, 1985). Yet, 94% of all schools surveyed appeared to have made some purposeful instructional decisions. An average of almost seven applications were reported. Most common usages, by more than half the schools, were mathematics, drill, tutorials (for a number of content areas), reading, and language arts. Forty percent of all schools offered students instruction in problem solving, social studies, and word processing.

When a question was posed about using computers and software to teach instructional objectives in several curriculum content areas, over 90%, or 321 schools, replied. About 60% of these schools reported that they were, in effect, integrating computing into the curricular areas.

Specific computing skills and understandings were a formal expectation in only 36% of all reporting schools. Outcomes of computing skills were measured less than 16% of the time in all schools, but some outcomes were measured "sometimes" in an additional 336 schools reporting.

Research Question 4. What local policy decisions are being developed or are in place to assure students instructional computing (or technology) opportunities?

In this policy subsection, the ancillary questions with relevance to local and district policy regarding computer acquisition, educational use, and access and participation are discussed. Formal policy decisions at the district level that contribute to local school educational activity were addressed in this portion of the study.

It must be reemphasized that local schools make many of their own policy decisions. Principals in 324 of 361 schools reported that their districts had already developed long-range instructional computing plans. In this study, this kind of commitment was indicated by responses to the categories of funding, maintenance, software, and whole-staff initial training and technological updating. A long-range district instructional computing plan was noted in an average of 52% of the schools. Plans were verified for 39% of rural, 64% of suburban, and 52% of urban districts. With 92% of the districts reporting, about 75% reported funding commitments to hardware, software, training, and maintenance.

While these figures are promising, it is possible that the individual district level of commitment to each and across all of these categories would reveal broad variation and, in addition, across high schools and middle schools and even among the elementary schools within the same district. Policy decisions were reported shelved, or only partially implemented, because of failed millages, staggered implementation processes, or such reasons as "We are proceeding with caution to avoid costly mistakes."

Voluntary written comments drawn from the statewide survey and the observations recorded during the six school-site visitations bore out the magnitude of variation in policies put into actual practice. "Our district has committed itself to K-12 computing, but so far that has meant the high school. All the elementary schools must fend for themselves."

Each of the six schools experienced varying levels of district commitment, even though school-board commitment had been made. For example, one school district recognized a volunteer teacher/consultant as the "district" consultant. Another school encountered a different set of circumstances. It found local means to provide on-site inservice for staff and to purchase computers and software three years before a district policy was formulated.

If students are to be provided with an instructional-computing curriculum, a district policy, it is assumed, would seek to insure the proper delivery of instruction through an ongoing staff inservice and technological-updating component. As a policy indicator, district commitment to staff training varied, as did the range of offerings. While 77% of 361 schools (278) reported that some training in Introduction to Computing was offered, only 141 schools provided it to 100% of their staff. No mechanism was included in the statewide survey to determine the depth, the content, or the attention to the ongoing nature or progression of inservice training. Further evidence of the variation of opportunity for teacher-focused educational-computing training occurred in other course categories. Ninety percent of staff in only (a) 17% of all schools were offered Instructional Applications of Microcomputers; (b) 11% of all schools, Evaluation of Instructional Software; and (c) 11% of all schools, some staff training in Managing Computers in the Classroom.

As was reported in the text of the six school-site summaries, district-sponsored inservices are only one means of providing teacher training. Individual teachers take personal courses, colleagues help colleagues, and local schools take responsibility for their own staff training, generated through computer-proficient enthusiasts on staff or through externally provided expertise.

A reliable indicator of the local school's potential for teaching students with and about computers was the answer principals gave to the question, "How many staff members do you perceive to be somewhat or highly qualified to teach the intended computer-related curriculum?" They believed that 68% of their staff would be able to do so. At the six school sites visited, principals' perceptions of staff readiness varied from 10% to 100%.

How, then, was it possible for teachers to teach the intended curriculum in these instances? The measures taken by the six schools unearthed an interesting phenomenon. While these sites were in the process of training their teachers, steps were taken to ensure that students were not deprived of ongoing computer education and consistent planned instruction. This effort to compensate for the initial variation in teacher capacity to teach the computing components was fully described in the site summaries. Local practices included the use of on-site experts, teacher/student laboratory settings supervised by consultants, large-group inservices with on-site follow-up, and so on. These interventions were viewed locally as only temporary, with high expectations that teachers would eventually teach the intended curriculum.

Thirty-six percent of all schools reported having 50 pieces of instructional software for an average-size student population of 386 students. Although the number of pieces does not speak to appropriate content or grade level, it does affirm an intention to acquire software that is believed locally to be of educational importance.

This brief review of policy implications based on survey data indicates that school districts have, in the main, adopted and proceeded within their own goal and financial structure to commit to an implementation of computing in their schools. However, the variation in provision of the basic elements of such an implementation across school sites and districts is apparent.

Also significant is the reported recency of these school-implementation efforts. A substantial number of schools and their districts were reporting, for example, "just getting under way in 1984." Others mentioned the goal of the 1985-86 school year. Sufficient feedback was collected to believe that school efforts, for the most part, were reinforced by at least some amount of planning and a considered purpose. Various funding sources and means of achieving ends have been used. Most district plans were long-range and structured. Implementing computers into the curriculum appeared to be a priority for most reporting schools. Just what this implementation and integration effort meant appeared to derive from a locally conceived "press" to prepare today's students for living in a high-tech society.

School Site Summaries

The six elementary school site visitations provided an opportunity for observation and description of supportive environments in which high access/participation educational computing opportunities were available for students and for teachers. Many of these attributes were discussed in connection with the statewide survey data in the preceding section of this chapter. These schools varied in the type of community they represented, their financial resources, the nature of the student body and faculty, and so on. Their similarities centered on a driving purpose to provide students with these opportunities.

The combinations of demographics and characteristics that appeared to help drive this focus were presented in Tables 27 and 28. It is notable that the principals' leadership, participation, and involvement emerged as the single recurrent microcomputer-education-facilitating program characteristic across all six sites. When considered in the aggregate, elements that seemed to contribute most to the prevailing atmosphere of high access, participation, and educational-use opportunities for students across the six school sites were (in rank order): (a) strong principal leadership, support, and involvement (the characteristic was strongly evident at all six sites);

(b) on-site computer-proficient helping expert (five sites); (c) ongoing inservice (four sites); (d) district commitment to concept and funding (three sites); (e) local enthusiasm by staff, students, and parents (three sites); (f) an involved district computing consultant (two sites); and (g) ample computers provided by creative use of time, scheduling, and sharing (one site). The attribute of creative usage, outstanding in one school, was also highly visible in all six schools studied and was noted in other computer-active schools reporting, probably because funding alone, in most cases, did not ensure "adequate-to-ample" computers for students.

These seven elements, when clustered by their content, indicate also the significance of those practices that promote the strengthening of staff educational-computing proficiency, such as on-site computer-proficient helping expert, coupled with an involved district computing consultant and ongoing and targeted inservice.

Summaries of selected results from interviews with principals, teachers, and computing consultants at six school sites.

1. Principals. Three principals were what Becker (1984a) called "computerists," early computer users who eagerly seek ways to translate computer potential into classrooms. The other three used computers, but not as computer "buffs." However, all six were involved in efforts to insure district-level attention to computer integration, had high expectations that all teachers would participate in teaching the intended curriculum, monitored the implementation, and were visible in assuring the importance of the computer as a tool to incorporate in

planned learning experiences. They instigated or collaborated with local teacher "buffs" and parents to acquire the physical components needed to provide broad access and participation opportunities.

2. Teachers. Two teachers were interviewed at each site except one school, where the principal believed one teacher would represent all points of view. Time was limited. Most interviews were conducted while the principal took a class period or during the teachers' planning time. Although a structured interview form was used as a guide, it proved more efficient to ask only the role-specific questions because answers to more general questions were extractable from other sources.

All 11 teachers agreed that incorporating educational computing at the elementary level is important or essential and that middle or high school is "too late." Some were avid computer users; others had varying degrees of experience and comfort levels with computers. None had been undergraduates when microcomputers were introduced into college education curricula, but they were eager to recommend components for preservice teacher training in instructional computing, including hands-on computing experience, at least simple programming, courseware applications in undergraduate content-area classes and in a "computers-in-education environment," and a requirement that all preservice teachers actually work with children, computers, and software in a simulated classroom environment.

Teachers' recommendations for inservice training included fewer immersion courses, such as Introduction to Computing, and more on-site, one-on-one assistance with applications. If inservice could be offered in small-group settings, they preferred that their co-learners be from similar grade-level or content-level groups and that they possess about the same degree of computer proficiency. Many characterized the larger district inservices as "off target." A Chapter I teacher believed that "teachers should share more with other teachers and with students and should not be afraid to be <u>uninformed</u> on their way to becoming informed about educational computing. Students need to see their teachers involved."

Oft-repeated suggestions for teacher involvement and participation were (a) time to learn the keyboard, explore software, and match curriculum to courseware, with support when needed from a computer-educator specialist; and (b) an opportunity to develop at one's own stage of readiness. Many felt forced into a role before they were technologically, intellectually, or emotionally prepared. Others complained of group training where those teachers who have some experience dominate the learning environment. Some teachers saw the computer as a tool, others as "just one more thing to do." A few teachers complained that too few computers made integrating computers into activities neither feasible nor efficient.

3. Computing consultants. In all six schools visited, a position of computing consultant was acknowledged. To clarify, two were official K-12 computing consultants with backgrounds as media specialists; they were appointed when the district implemented a K-12 curriculum-integrated program. One was a K-8 consultant, former

teacher, and computing enthusiast who was hired for six-tenths time but subsequently recommended for full-time and K-12. The fourth was a special education/general education teacher who taught a computer class and volunteered all extra time to helping teachers and students. Hoping for an official appointment, she was recognized by the district as the unofficial consultant and spokesperson for all computing matters. Another was a volunteer and computer expert who was hired to supervise the elementary laboratory. He hoped for an eventual K-12 assignment. The sixth consultant interviewed was appointed K-12 consultant after the local school in his district was selected for study. That local school's actual resident consultant was a computer-using teacher enthusiast. The recently appointed district consultant's role was an addition to numerous other districtwide responsibilities.

In years, consultancy assignments represented two with four or more years, three with about one and one-half years, and one with only a few months. Role-specific responses of interest were the following: All six computing consultants stated that teachers eventually must be active participants in the delivery of student instruction in the context of appropriate software presented at the appropriate content and learners' "moment in time." They saw this as a gradual process, and one in which the consultant's role was that of help, encouragement, and providing appropriate software, classroom-management techniques, and one-on-one help when needed. Two stated they were spread too thin to do this job adequately. Funding for ample machines, courseware, and especially released time for teachers to explore the new technology was an essential requirement. All received their training in various ways: self-teaching, keeping up with the literature and research, taking classes of interest, and attending educational-computing conferences and workshops. None was degreed specifically to teach computing.

A veteran in the role of district computing teacher/consultant summarized: "It is important to put computers in the context of what teachers are teaching and students are learning everyday." In citing the prevalence of teacher anxiety about using computers with students, she said, "Think of the elementary teachers who teach six subjects! How can computers help them do _that_? Then, show them software that _will_, and give them time and space to make the transition." Her rationale for helping teachers learn to use computers with students was: "Students can learn by 'watching teachers be students.' The teacher and computer together can move students toward conceptualizing; there are as yet so few teachers who can help students to do that, and yet, that's what teaching is all about."

Conclusions

1. Michigan elementary school staffs and their school communities have found both traditional and entrepreneurial ways to develop educational computing programs. (See Table 9 for specified alternative funding sources.) For example, one school obtained its computers through a one-time district allocation, another by a series of local fund-raising activities. Thus, resources can be described as

varied and often dependent on recurring local initiative. Some schools have full district funding and commitment, whereas others have acquired computers from external funding sources, such as Chapter I or Chapter II. This type of acquisition causes an unevenness of provision and a dubious ability to fulfill a long-range, educationally meaningful commitment across school sites.

2. The extreme range in the ratio of students to one computer across all community types predicts a developing pattern of limited access and participation opportunities for some students who must depend on the public schools for their initial encounters with new technologies. This research finding corroborates the serious issue of inequitable access to educational technology for Michigan students described by Salas (1983).

3. Computers were used only 50% or more of the time in 38% of the reporting schools. Some of this may be due to the fact that computers had been purchased with funds that stipulated use by special-needs groups. Other reasons might involve computer scheduling, location, absence of trained and available personnel, or software that does not match classroom needs.

4. In 321 of 361 schools, 62% reported offering a range of curricular applications. An average of seven applications was checked, which tends to indicate an intention to treat computers more as a tool than as "add-ons" to the school curriculum. Only a few of the more promising uses noted by Brophy and Hannon (1984) are beginning to be

reported in significant numbers by Michigan elementary schools; for example, 34% for simulations and 44% for problem solving.

Essential skill building using drill and practice software, reported to be beneficial for some educationally disadvantaged students, occupies much of the present use-time of designated Chapter I computers.

5. Schools participating in on-site interviews reported that while K-12 implementation is their direction, the elementary students were the first target group for total immersion in a computing curriculum, even though some programs were offered to middle/junior high school and high school students. This could indicate that other schools, as well, may be moving toward a "bottom up" integration and implementation of computing through the curriculum.

6. While educational-computing user groups develop and flourish, the opportunity offered by networking to enhance local knowledge and offerings among and across school sites is as yet underused. For example, only 19% of rural schools reported networking, that is, sharing information on successful practice, research, and technological updating.

7. Teachers interviewed on site reported the best and most personally helpful source of inservice training is the delivery of such technology at the site. Interventions from computer teacher consultants, they suggested, should be timed to meet local needs and individual teacher readiness. Software presentation should be relevant to what their students are actively doing in content areas.

While most schools that offered whole-staff inservice chose as a priority Introduction to Computing, there was no way to interpret the depth, consistency of follow-through, content of, or target audience selected for inservice presentations. Since teachers in elementary schools are more likely to be the deliverers of classroom computing instruction, the disparate nature of inservice offerings across all school sites points to a significant variation in what students, as a consequence, experience in their microcomputer-education opportunity.

8. While funding is basically important to the implementation of an innovation, it was possible for some elementary schools to develop a high-access computer education program for most students by evidencing a combination of characteristics, which energized the school and surrounding community to acquire computers, software, and training and to implement an instructional plan. Similar kinds of supporting environments as those described by experts such as Hunter, Dearborn, and Snyder (1983) and the experts queried before this study (see Chapter III) seem to produce, at least for a few years, high-access and high-participation opportunities for students. Whether a local school, without assured and continuous funding and continuous external support, could sustain such an energetic local effort is questionable. However, in the written comments accompanying returned surveys and through observations at the six schools, it was clear that local leadership, enthusiasm, an available computer "buff"/expert, commitment and support, and targeted inservice opportunities could combine to provide

a viable local instructional computing program, even when financial resources were scarce.

On the other hand, opposite situations were reported, in which schools did indeed have the material resources but had failed to provide high access/participation opportunities for students. One principal whose school had a 12:1 student-computer ratio commented in part, "I would enjoy sending you a brief description of our successes. If you're interested in our failures (i.e., staff enthusiasm, inservice, CMI), I am at your disposal."

A substantial number of schools that possessed the machines and peripherals to be able to provide a range of opportunities for most students did not. Evidently in these cases a combination of facilitating characteristics was absent.

9. Policy and practice issues are inherent in the characteristics just delineated. Fifty-two percent of local schools or their districts have developed a long-range policy commitment to both an educational computing plan and its implementation.

When local schools individually make policy decisions about educational computing, it may be because of a lack of, in spite of, or sometimes in addition to a district decision. Whether written or less formally articulated, there frequently are goals developed and procedures embraced by the local school as a unit. Deal's (1985) perspective that a local school culture has inherent rituals and traditions that help characterize its entire activity was borne out in this study. Some school communities appeared to forge ahead to obtain what they believed was needed. This phenomenon of grass-roots effort was noticeable in the comments offered in writing by 24 schools (nine suburban, eight rural, and seven urban) that initiated computing programs and obtained computers on their own with the help of parent, student, teacher, and/or community groups. Two other schools stated that their total computer "program" depended on micros brought to school by staff for student use.

Follow-through on district and local policies was not readily measurable in a one-time survey. It appears, however, that there are inconsistencies across the range of stated and actual commitments to funding, teacher training, equipment, software, and maintenance and updating, probably caused by local inability to fund at consistent levels, lack of use of or absence of external support structures, and uncertainty about what it is best to do.

Summary

The amount of computer activity present for students in a sample of Michigan elementary schools indicates, at the very least, an active rather than passive concern about providing instructional computing opportunities. School responses could be characterized by the comment of Koetke (1984): "Certainly there is much research to be done . . . , but there is much to be gained and minds to be lost by using that as an excuse for doing nothing today" (p. 163). One computing expert believed that educational computing might advance in schools in spite of insufficient funds because "people are too invested in it" to relinquish or shelve it so early in its development (ASCD, 1985, p. 8).

Recommendations for Practice

1. There is a disparity of dollars spent per pupil on instruction in Michigan public schools (Michigan State Board of Education, 1983), and because of a tradition of local autonomy in schools, there are differences also in the way local policy makers choose to designate funds for selected purposes. (Microcomputers in schools, for example, may or may not be an officially sanctioned expenditure.) This study reported a variety of ways in which funds were acquired and/or allocated to implement an innovation, specifically microcomputers in education.

Consistency is needed. The annual 2% of the local instructional budget as a commitment to the implementation, suggested by Moursund (1984c), is recommended as a start. While some schools and districts may not be convinced that any such effort is warranted, it makes more sense to provide and fund an enabling plan than to deal sporadically with innovations in the curriculum when change is inevitable. Short-term or one-time local funding precludes the opportunity to tie computers and software into ongoing curriculum planning. School staffs need to evaluate what computers will do best at present, so that computers, software, and funds are not misused, but used well. They can then earmark or reallocate funds to those areas where sufficient computers are predicted to do that job best.

2. Even if such financial and philosophic commitments have been made locally, educators and policy makers, statewide, must help establish a course of action that includes funding to assure students

in Michigan public schools access to essential instructional computing opportunities. Local and state professional organizations need to derive and affirm which current applications will likely make a difference for students. Then concerned individuals and groups must collaborate to advance appropriate legislative and educational agendas.

If 52% of the reporting elementary schools do already have a long-range plan, surely enough is known about the value of computing and technological education to move toward providing funding and recommendations for "adequate to ample" and appropriate opportunities for today's Michigan school students.

3. By the 1985 school year, each school, agency, and concerned professional organization should have assigned at least one person as the instructional-technology liaison. Whether or not a school has yet to own a single computer, or whether or not an educational or business organization has yet to make an official commitment to the concept of educational computing opportunities for Michigan students, each has a stake in the outcome and must participate in insuring and providing what is necessary. "Everyone," said Pea (1984), "is a shareholder in this reformative enterprise: teachers, parents, researchers, industry, business, and policymakers" (p. 13).

4. Networking is a natural next step for each school unit or concerned organization that has assigned an on-site computer-technology representative. This individual would assume the role of local advocate and information specialist and would help identify both local needs and resources to share with a larger network of schools,

organizations, and businesses. Networking is a vital and necessary practice to assure the promotion of the best that is currently known about instructional computing for students. Eichner (1984) said, "Schools simply cannot continue to function without sharing their resources" (p. 1).

What does networking mean in a state where a school may be one block or many miles from another, or hours of travel away from its designated intermediate school district (ISD) resource center or higher education contact point? The representative mentioned would inform, draw from, and fully participate in a statewide network that shares research and practice information, as well as ways and means of implementation. All the stakeholders form the network. The focus of the stakeholders is on the equitable delivery of appropriate instruction to Michigan public school students.

5. Local schools must be able to expect their ISDs to anticipate and help serve the instructional needs, which go beyond the scope and capacities of a single school or district. If this expectation is not realistic, politically correct, or politically expedient, it is nonetheless an assumption that is widely held by local educators. All teachers interviewed at the six school sites commented about service from their local ISD. Some reported a variety of computer-related services, whereas others reported no options available. But they all expected that it was their ISD's responsibility to provide some kinds of technical and/or resource services that area schools might not be feasibly equipped to generate.

At present, the services and technology offered by ISDs to their constituencies are varied. Some offer consultants, service to schools, demonstration centers, resource/materials preview centers, and so on, whereas others may offer only a single resource. For example, 69% of the reporting schools reported "no" regularly available computing consultant from an ISD.

It is essential that the ISDs and their regional educational media centers (REMCs) be active participants in the promotion and delivery of equitable opportunities to their constituencies. Local ISD boards and REMC advisory councils must develop action plans to provide technological updating for their client schools. Such an action may imply some restructuring of the ISD's present agenda.

6. A most important task for the State Board of Education must be to evaluate the present policies and practices of ISDs and their REMCs, especially in relation to the equitable delivery of educational computing and other new technologies. Any computer-related Department of Education staff positions should be evaluated and adjusted to enhance the potential outreach of all available staff.

An additional suggestion entails the appointment of an interim, full-time action researcher to help define and establish a baseline of what constitutes an essential instructional computing program. The researcher would also identify those schools and districts that are apparently technologically unserved or underserved. Offers of appropriate assistance and specific targeted interventions would ensue. An effective way must be found rather expeditiously to determine, monitor, and assure some measure of equity in the provision of essential educational computing opportunities for Michigan students.

7. In Better Education for Michigan Citizens (1984), the Michigan State Board of Education stated that recommendations will be made to the Governor and legislature for funding. With each passing day, the gaps between served and underserved students widen (Salas, 1983).

The block-grant funds, mini-grants for special projects, and some funding of hardware and software for science and mathematics improvement are a few ways Michigan public schools may now access state funds for microcomputer-related purposes. In the second half of the 1980s, the legislature, guided by local and national research, must begin to allocate funds to help alleviate the inequity in unserved schools and to promote equity in schools where, for various reasons, students appear to be underserved. There is no substitute for students and teachers having hands-on, meaningful experiences.

Stasz and Winkler (1985) found the best way for districts to foster improved microcomputer use in classrooms is to build a stock of microcomputers and hardware backed with centralized technical assistance, including curriculum-appropriate software selection and evaluation. Other teacher incentives, they predicted, will be needed to stimulate and sustain teachers' motivation and interest in staff development.

Whatever funding interventions the legislature makes, the decisions must contain long- and short-range expectations and goals so that schools will be led to make only the broadest and most effective educational uses of their technology. This implies not only self-reporting of progress, but external help with monitoring, evaluating, and adjusting results to complement a well-researched yet flexible plan that takes into account new research, changing technologies, and the changing knowledge base of students learning with technology.

8. Professional organizations such as the Michigan Association of Computer Users in Learning, the Michigan Reading Association, the Michigan Council for Teachers of Mathematics, the Middle Cities Education Association, and Michigan colleges and universities should engage in collaborative efforts to inform the field and advocate the advancement of new technology for all students.

9. If educational computing is to reach its full potential, educators will need to keep their schools' computers out of the closet and maintain a visionary sense of the program, in spite of few means. Software will improve. Perkins (1985) said, "There will be plenty of mediocrity, but also plenty of enlightened applications." To assure that the full value of computing for students is not diminished, principals must be responsible leaders in finding and promoting the best school uses of computers. Principals and other school administrators, individually and within their professional groups, need to study their role in the development of technology. The leadership of the principal was the single most important factor in promoting high access/participation opportunities at each of the six school sites studied.

10. Educators must ask, What are the unique educational roles for computers in public education? What policies and practices seem to promote high-access and high-use experiences for students? What educational skills will be required to handle the information glut? What can technology do best? How can the typical classroom activity be enhanced by computers? How can teachers be helped to accommodate these usages? How can teachers help provide the supporting environments needed for students to have meaningful experiences?

11. It is vital that teachers in Michigan schools have the assistance, opportunities, resources, and time to develop the skills they need to make classroom experiences for students optimal. But there is only so much time in a day, too many "add-ons" and "pull-outs" already, and scarce resources, at best. If an essential curriculum is agreed on, computers can be infused wherever in that curriculum they will have the greatest effect.

What is essential, then, is that teachers be included in all planning. Outstanding during the on-site visitations was the rich informational and experiential data provided by teachers. Teachers must be invited to participate in state and local planning for educational computing. Perhaps their richest contribution will be to other teachers. Many self-taught computer-using teachers have ideas and skills to share, but no opportunity either locally or regionally to showcase successful practices. Blue-ribbon planning committees frequently include administrators, consultants, university and educational-agency representatives, and legislators, but they exclude teachers. The reason is usually that teachers need to be in their classrooms when such committees meet. Some creative restructuring is needed to permit teachers to be included in ongoing planning and participation in the development of educational computing/technology in Michigan schools.

Recommendations for Research

Those who are responsible for public education or who are stakeholders in the outcomes of student learning in Michigan must cooperate to establish and perpetuate a knowledge base for the ever-changing field of educational computing.

1. It is recommended that a replication of the present study be conducted so that what is happening in the schools may be recorded and comparisons or changes over time can be noted.

2. The present survey yielded data of interest to practitioners and researchers in Michigan. It was found to be cost effective and simple to administer. Therefore, a similar survey of middle/junior high schools and senior high schools is recommended. There would be value in replicating these studies over time to gain insight into either progress or problems revealed while implementing an innovation.

3. A statewide research network is needed to establish a knowledge base of current local and best practices. Schools need to be informed about best local and national practices. Michigan researchers need to abstract, synthesize, and disseminate research in a clear, timely, and focused manner.

4. Michigan universities and colleges must find and aggressively adopt ways of sharing their projects and findings with each other. Funded studies, dissertations, state-level surveys, and so on, should be feeding into school practices. University collaboration will not only help promise the best use of current research, it will encourage the identification of needed research.

5. Local schools need external guidance in documenting their successful practices. These summarized findings will be useful in classrooms, university-based laboratories, and special regional demonstration centers, as well as to inform planners, producers, and national networks.

6. Collaborative research between schools and universities needs expansion and strengthening. In Michigan, there are obvious advantages for those public schools that are geographically near university settings. However, doing collaborative research primarily with schools in proximity to the institution has serious limitations. First, schools at a distance may sorely need to be involved in developing an educational computing program but may not be aware of the importance of doing so; therefore, they do not initiate the effort. Second, the great distance between most universities and many of the state's public schools is a very real challenge. Perhaps it will be the creative use of computers that will begin to bridge the unreached or underserved schools. Third, universities need the participation of public schools that represent a broad range of demographics and

community types if the research is to be useful to a representation of Michigan's public schools.

7. In Michigan, research is needed on the roles various segments of the school professional population represent. School leaders, for example, need to know what role to play, as do teachers, computing consultants, school boards, and governmental-agency computing personnel.

8. State professional organizations, such as the Michigan Association of Computer Users in Learning, are rich resources of computer-education research and practice. Each organization has its own journal, bulletin, or newsletter. But schools presently must tap these references separately. Few local schools have the financial wherewithal to subscribe to the available publications, even if aware of their usefulness. And yet, these publications represent the research and practice of current interest to schools. Professional organizations need to find efficient ways to synthesize research for individual schools.

9. Research is underway that encompasses the many specific subjects related to the major topics of children learning with computers and teachers teaching with computers. Overall, researchers have identified the many crucial and intriguing topics surrounding the role of computers in schools. These activities were extensively reviewed in the review of literature section. The recommendations in this section focus on some of the current needs in Michigan for better use of existing research, especially local research, and for the

initiation of collaborative efforts to extend research into needed areas. Even though there are current disparities in the distribution of available educational computing resources and inequities in access and participation opportunities for teachers and students, it is essential that "what is" helps inform "what happens next."

10. Driven by the spirit of an innovation, schools have an opportunity to refocus on an overall school-improvement effort. Local research on and planning for instructional computing provide a meaningful context for looking at teaching, learning, quality, and equity.

Reflections

This dissertation is briefly titled "The child's present in a future-oriented society." The focus of the study was on how schools are responding to technology in behalf of the students in Michigan's public elementary schools. All the words incorporated to discuss the topic of microcomputers--equity, funding, policies, applications, inservice, peripherals--were not meant to detract from the major focus of the study, today's student, the "child."

Elementary educators are only in business because of, and for, children. Whatever constitutes an essential, appropriate, and adequate public education for one child must accrue to all children in Michigan public schools. The researcher concluded that there is much and varied instructional-computing activity prevalent in Michigan elementary schools. The concern remains that what has been found to be "good" or "useful" for children to know and be able to do with computers be transmitted across school sites by those responsible.

Some schools and their communities have found creative ways to provide an educational-computing curriculum, in spite of scarce resources. Local enthusiasm, leadership, commitment, acquisition of expertise to do the job, and a good plan carried their efforts forward. But, overall, Michigan children are very dependent on an extremely uneven provision of whatever has been deemed "essential."

> We can, whenever and wherever we choose, successfully teach all children whose schooling is of interest to us. We already know more than we need to do that. Whether or not we do it must finally depend on how we feel about the fact that we haven't so far. (Edmonds, 1983, p. 35)

APPENDICES

APPENDIX A

COMMUNITY TYPES

MICHIGAN DEPARTMENT OF EDUCATION

MEMORANDUM

May 10, 1978

TO: Stephanie Zimmermann

FROM: June Olsen June

SUBJECT: Lists of Schools for Drawing Samples

This year we will be drawing our own samples of schools for the various types of experimental testing. In order to do that, we need to have the schools stratified and listed according to our specifications. I would like you to relay our request to Rod concerning the stratification and specifications.

First of all, there should be 3 complete lists--1 for grade 4, 1 for grade 7 and 1 for grade 10. There will be 6 strata of districts. The table below shows the community type and region for each stratum.

Stratum	No. of Bldgs 4	7	10	Community Type	Region
1	271	99	45	I, II	1
2	310	70	51	I, II	2
3	462	158	105	III, IV	1
4	401	145	133	III, IV	2
5	244	169	151	V	2
6	290	167	149	II, III, V	3, 4
Total	1978	8[illegible]	637		

For each grade, then, there will be 6 lists. The format of each list is shown on the attached layout sheet.

The main difference in the printed lists this year is that the entire stratum should list the districts in county-district order. Another difference is that there will be no individual district total. The final, major difference is that the community type should be printed for each district listed.

The attached layout sheet, hopefully, portrays what we have in mind. I have attempted to show what stratum 3 for grade 4 might look like. At the end of each stratum there should be a grand total of students and the number of buildings included in the stratum.

One last thing is that, obviously, only those schools with enrollment in the appropriate grade should be listed. Please let me know if you or Rod have any questions.

I hope to be sending you the tape with 1977-78 enrollment on it by the end of this week. After you receive it, there will have to be some corrections made for a few of the schools in the grade enrollment area. The problem is that in a few schools the enrollment did not get keypunched so the fields show 0's. In 2 cases, the figures that appear on the tape are incorrect and should be replaced with those we are providing you.

If I were to wait for the Department to correct the tape, we would not be able to have it before the first of June and we need to have the lists for drawing samples by May 22nd. The corrections to be made are enclosed.

JO:cc
attachments

cc: Ed Roeber
Sharif Shakrani

LISTING OF MICHIGAN SCHOOL DISTRICTS CLASSIFIED BY MAJOR COMMUNITY TYPE SERVED

This list contains 604 school districts that were in existence as of December 31, 1972, classified by community type. Of these, 529 were organized to operate K-12 programs. The remaining 75, which are denoted by an asterisk (*), were not organized to operate a K-12 program in 1972-73.

DEFINITIONS

1. Metropolitan Core Cities:

   Communities are classified as Metropolitan Core Cities if they meet at least one of the following criteria:

   (a) the community is the central city of a Michigan Standard Metropolitan Statistical Area; or

   (b) the community is an enclave within the central city of a Michigan Standard Metropolitan Statistical Area.

   (c) the community was previously classified as a Metropolitan Core City.

   Note: The U.S. Census Bureau defines the central city of a Standard Metropolitan Statistical Area as those cities named in the titles of the Standard Metropolitan Statistical Area. (See U.S. Department of Commerce, Statistical Abstract of the United States [Washington: Bureau of the Census, 1968], p.2.)

2. Cities:

   Communities are classified as Cities if they have a population of 10,000 or more and have not been classified as a Metropolitan Core City or Urban Fringe.

3. Towns:

   Communities are classified as Towns if they have a population of 2,500 to 9,999. Rural communities impacted by large military installations nearby are also classified as Towns.

4. Urban Fringe:

Communities are classified as Urban Fringe, regardless of their size, if they meet at least one of the following criteria:

(a) the mailing address of the community is a Metropolitan Core City or a City unless it is on a RFD Route; or

(b) the community is within ten miles of the center of a Metropolitan Core City; or

(c) the community is within five miles of the center of a city.

5. Rural:

Communities are classified as Rural if they have a population of less than 2,500, or if their address is an RFD Route of a Town, City, Urban Fringe, or Metropolitan Core, and they lie outside the perimeter defined above under Urban Fringe.

NOTE: No communities in Wayne County are classified rural.

These definitions of community types were established in the fall of 1971. They have been developed to make the classification as objective and consistent as possible without altering the basic principles of classification. All classifications have been made using 1970 census data and the most recent address available for each district.

The numbers preceding school district names are Department of Education county and school district code numbers. The first two digits refer to the county, and the remaining three digits refer to the school district within the county. A key to the county code numbers follows the lists.

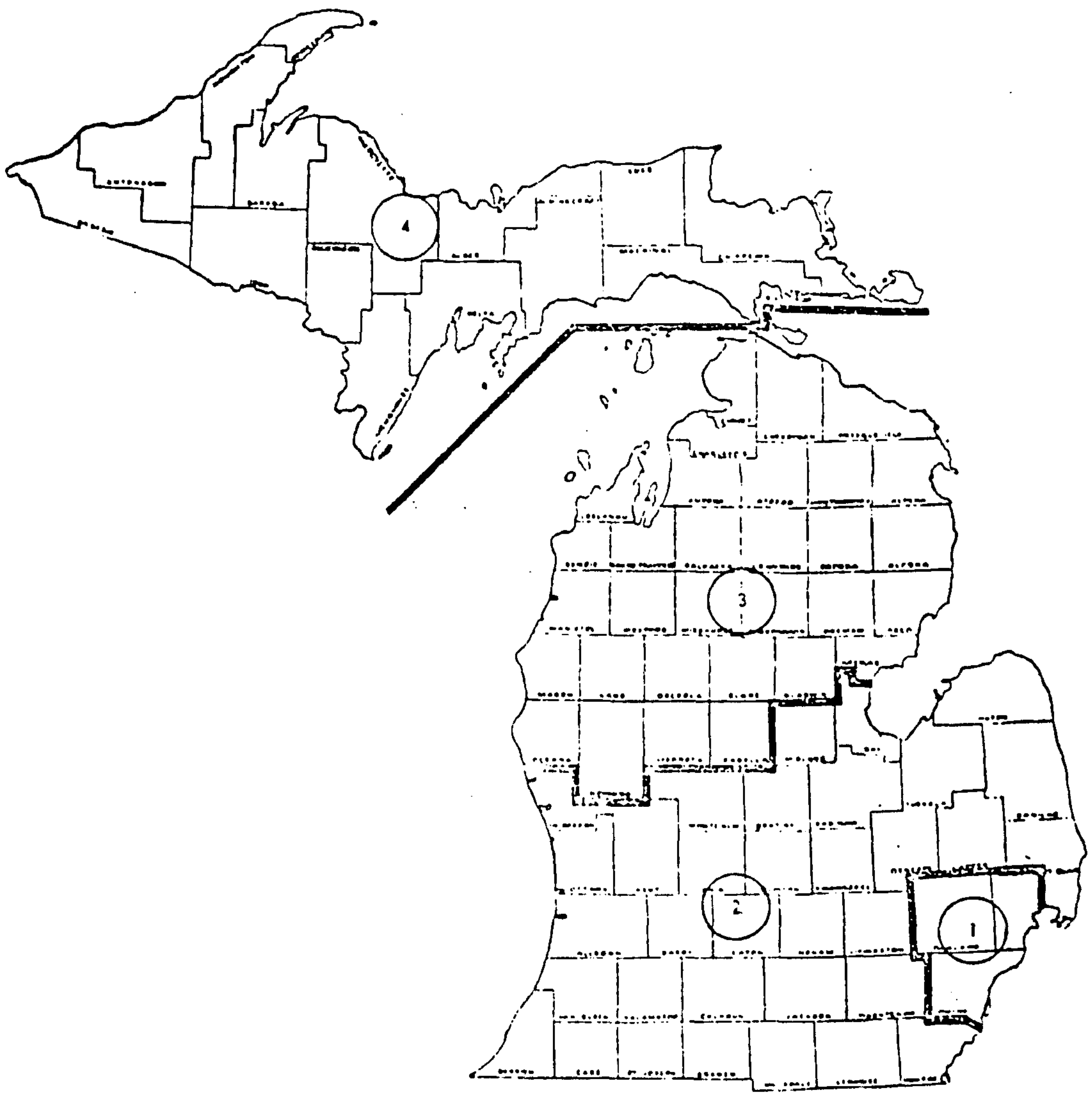
REGION AND COMMUNITY TYPE CATEGORIES

Region 1 - Wayne, Oakland and Macomb Counties.

2 - All counties in Southern Michigan that are south of and including Muskegon, Kent, Montcalm, Gratiot, Midland and Bay counties. This excludes Region 1.

3 - All counties that are north of the above mentioned line and that are in the Lower Peninsula.

4 - All counties that are in the Upper Peninsula.



DESIGNATION OF COMMUNITY TYPES*
for purposes of this study

STRATUM		COMMUNITY TYPES	REGION
"Urban"	I =263	Metro Core (I) City (II)	Tri-County Detroit (I)
"Urban" (TOTAL URBAN	II =304 = 567)	Metro Core (I) City (II)	Out-State, School Dist. of Mt. Pleasant (II)
"Suburban"	III=411	Town (III) Urban Fringe (IV)	Tri-County Detroit (I)
"Suburban" (TOTAL SUBURBAN	IV =393 =804)	Town (III) Urban Fringe (IV)	Out-State, School Dist. of Mt. Pleasant
"Rural"	V =238	Rural Communities	Below a line in Mid-Michigan with a popu-ation less than 2,500 or if address is R7D route of a town, city or urban fringe or metr area
"Rural" (TOTAL RURAL	VI =283 =521)	Rural Communities	Out-state communities with a population less than 2,500, or if add-ress is an R7D route of of a town, city or urba fringe
TOTAL:	=1892		

*provided by Michigan Department of Education,
Office of the State Dept. of Michigan.

APPENDIX B

CORRESPONDENCE AND SURVEY INSTRUMENTS

STATE OF MICHIGAN

DEPARTMENT OF EDUCATION

Lansing, Michigan 48909

PHILLIP E. RUNKEL
Superintendent
of Public Instruction

March 29, 1985

Dear Principal:

SUBJECT: SURVEY OF LEVEL OF USE AND IMPLEMENTATION OF INSTRUCTIONAL COMPUTING IN MICHIGAN ELEMENTARY SCHOOLS

Enclosed is a questionnaire which has been prepared for distribution to a random sample of Michigan public elementary schools. The survey is part of a two-tiered dissertation, which is investigating the level of integration of microcomputers and the educational uses of computers by instructional staff in Michigan elementary schools. The questionnaire is the first phase: eight case studies will subsequently be developed in varied school settings to help establish helpful alternative models. Characteristics which seem to facilitate a high participation atmosphere for both students and teachers will be identified.

The study is of interest to the State Department of Education for a number of reasons. The Blueprint for Action, for example, has encouraged the gathering of data on educational computing in our schools. Local school leaders and agency planners need more of this kind of information to make policy decisions about approaches and best uses of computers to enhance student learning. The Office of Technical Assistance and Evaluation is also interested in gathering information on effective practices and effective teaching emanating from creative uses of computer-assisted and computer-managed instruction. We believe this data and the information from the case studies can be utilized to assist schools with short and long-range planning. The survey is both an inventory and a means of determining any trends, emphases, problems, or as yet unexplored possibilities. It has been piloted with computer educators and principals, so that appropriateness and ease of completion will encourage your participation. (Still, not all questions will fit your local situation, but please respond as completely as is possible.)

The dissertation is being completed within the Department of Education Administration at Michigan State University where there is active interest in investigating the preservice and inservice needs of educators. Therefore, the information you as principal, or your designate, takes time to provide, will enrich our knowledge base. All responses will be held in confidence. Data will be used only in the aggregate; no school name or individual's names will be included. When the dissertation is completed, the general findings of this survey will be summarized. If a copy would be helpful to you, please check "yes" on the survey and Beverly will forward the summary to you through our office.

Principal
March 29, 1985
Page 2

Please complete the questionnaire and mail in the enclosed stamped and addressed envelope by April 18, 1985.

Thank you for your assistance and participation.

Sincerely,

David L. Donovan
Assistant Superintedent
Office of Technical Assistance
And Evaluation
Ottawa Street Office Building
Lansing, MI 48909
(517) 373-8374

Beverly A. Bancroft
Research Assistant and Student
Department of Educational
Administration
418 Erickson
Michigan State University
East Lansing, MI 48824
(517) 353-9024

pg

Enclosures

May, 1985

To the principals, teachers and computing coordinators for six elementary public schools in Michigan involved in an informal interview process as part of the second tier of a doctoral dissertation study being conducted through Michigan State University, Department of Educational Administration, and the State Department of Education, Office of Technical Assistance and Evaluation.

______________________________ School ______________ Date

STATEMENT OF CONFIDENTIALITY

"ALL INFORMATION WHICH WOULD PERMIT IDENTIFICATION OF RESPONDENTS OR THEIR SCHOOLS WILL BE REGARDED AS STRICTLY CONFIDENTIAL, WILL BE USED ONLY FOR THE PURPOSES OF THE STUDY, AND WILL NOT BE DISCLOSED OR RELEASED FOR ANY PURPOSE WITHOUT PRIOR CONSENT, EXCEPT AS REQUIRED BY LAW."

The data gathered on site today will be used only in the aggregate. Taped portions will be erased as soon as data are recorded on official questionnaire.

I am most appreciative of your time and willingness to share the important activities that have resulted in your school's being selected as high availability/participation for all children in your school, in regard to instructional computing.

____

Beverly A. Bancroft
418 Erickson
(517) 353-9024
Research assistant and student

THE RANKED RESPONSES OF 17 EDUCATIONAL COMPUTING EXPERTS WHEN ASKED TO LIST FROM FIVE TO SEVEN CHARACTERISTICS WHICH THEY BELIEVED WOULD BE PRESENT IN A SCHOOL OR DISTRICT WHERE A HIGH DEGREE OF EDUCATIONAL COMPUTING ACCESS AND PARTICIPATION OPPORTUNITIES WERE ASSURED FOR MOST STUDENTS

1. Administrative or principal support, involvement and encouragement............................93%
2. Adequate funding.......................................64%
3. Continuing and appropriate quality inservice............50%
4. Enthusiasm for computers and computing by leaders....... teachers and students......................50%
5. Well-detailed plan for integration of computers into.... curriculum................................43%
6. Adequate to ample number of computers for students..... and open access to them....................43%
7. A computer consultant or leader on local or district staff.....................................36%
8. High expectations for educational computing and commitment to concept and funding by Board.......36%
9. Broad range of applications visible; emphasis on....... applications..............................29%

Department of Educational Administration
418 Erickson Hall
Michigan State University
East Lansing, Michigan 48824

Dear___________________________:

Will you, as an elementary principal, serve as my expert for completing this survey, which will go to a large sampling of elementary principals in Michigan, as I study the level of access and integration of educational computing for students in our elementary schools. It will have useable data for educational planners and local districts, and will be the data portion of my dissertation.

I want it to be easy to understand, to complete, and appropriate for the elementary setting.
Please circle in RED any statements or questions which caused you too much deliberation time. Not ALL questions will be applicable to your site. There are a wide range of LEVELS, so I am trying to hit the broadest spectrum.

Make any comment, as tersely as you like, which will help your colleagues fill out the "finished product." The survey will be revised to accommodate your comments.
Please return in the enclosed envelope within five mailing days.

I have asked only five principals to serve as experts. I do thank you. My telephone number afternoons is 517/353/9024. I am research assistant in School Improvement/ with Dr. Larry Lezotte while on campus. Thanks for your time and expertise.

Sincerely,

Beverly Bancroft

MICHIGAN STATE UNIVERSITY

COLLEGE OF EDUCATION
DEPARTMENT OF EDUCATIONAL ADMINISTRATION
ERICKSON HALL

EAST LANSING • MICHIGAN • 48824-1034

October 17, 1984

LETTER SENT WITH STATEWIDE SURVEY QUESTIONNAIRE FOR INPUT FROM FIVE EDUCATIONAL COMPUTING EXPERTS. QUESTIONNAIRE WAS THEN REVISED AND SENT TO FIVE ELEMENTARY PRINCIPALS FOR INPUT -

Dear Colleague:

The attached list of characteristics have been rank ordered by frequency of occurrence. They are the responses of seventeen instructional computing experts to an opinionnaire prepared to precede the development of a questionnaire to be distributed to a random sampling of 600 elementary principals. The subject of the study, generally, is the status of the implementation and integration of instructional computing into Michigan public elementary schools. The computing experts were asked to list characteristics they believed would be present "in a school (or school district) where students are provided with high degrees of access to computers and high degrees of participation (or use) opportunities with computers and instructional computing activities. (Example: funding cokmitment). They were asked to list and rank at least five, but no more than seven.

Using their input, and the knowledge you have gathered from research and practice, I am asking you to review the questions which I have created to be put in a questionnaire for elementary principals. The questions need to reflect not only the access and use time which elementary school students now have with computers, but what educational uses are prevalent. Also the policies and practices of schools in acquiring computers and peripherals, staff training and technological updating, software present at the site, and present and ongoing plans are of interest, both to local educators, and Michigan educational agencies, as well. Even though I have used many sources to obtain good questions and have reduced the number of questions from 60 to 29, I know that the content may still be unclear or of questionable value. I will use all your suggestions to improve the overall content and effectiveness of the instrument.

My dissertation is in two parts. You are helping me with Part One, which is, in fact, an inventory of "what really is happening in educational computing in 600 rural, suburban and urban Michigan public elementary schools." The second part of the study will focus on six school sites which evidence high access and participation opportunities for most students, and show a combination of facilitating characteristics from the attached listing. Many such studies of base-line data are needed. I appreciate your willingness to critique the enclosed survey questionnaire. You work with students, teachers, and administrators in the context of microcomputer education on a daily basis, so your insights and contributions are highly valued. I will put you in touch with the results of this study. Thank you.

Sincerely,

Beverly A. Bancroft
Graduate Assistant/Lezotte

Attachments: Results of opinionnaire to obtain characteristics
Questionnaire for principals to be edited - and a stamped return envelope.

A BRIEF SURVEY OF THE INSTRUCTIONAL USES OF COMPUTERS IN MICHIGAN PUBLIC ELEMENTARY SCHOOLS, 1984-1985

Name____

(If not Principal) TITLE______________________________

School Name_______________________________________

District Name_____________________________________

Address____

____________________________Zip________

Phone ________/___________ [________YES, SEND SUMMARY]

1]__________Total number of students enrolled in your school.

2]__________Total number of full-time teachers in your school.

3]__________Total No. instruc. support staff (i.e media).

4]__________Total number of elementary schools in district.

5]__________Total number of computers for students' instructional use in your school.

What is the ratio of students to (educationally dedicated) computers in your school?....................

6]____________(students) to 1 (computer)

7] Does your building receive any computer-related financial assistance from: (Please check any that apply)

________Chapter I ECIA; ______CH.II ECIA;

_________Part B of the Ed. Handic. Act. P.L.42-142;

________Community groups or local businesses;

________Other sources outside regular school allocation?

8] Please check grades included in your school:

_____K ____1 _____2 _____3 _____4 _____5 _____6

9] Please check any grades which participate in <u>planned</u> instruction with microcomputers.

____K ____1 ____2 ____3 ____4 ____5 ____6.

If more than one section per grade, do all grade sections receive similar computer time allotment and instruction? ______Yes ______ No ______NA

10] What percent of the time do you estimate <u>all</u> your computers are used instructionally during the official school day? _____0-25% _____ 26-50%

_____51-75% _____ 76-100%

11] Does your school provide computers which students can access other than during regular classroom time?

_______Yes _____No (If "yes," please check all that apply): _____Before school _____Lunch _______After school?

________Total no. available for general access.

12] What are the locations of the computer terminals/ micros in your school?

______Classrooms Permanently stationed? _____Yes ____No

______Media Cntr/Lib. Permanently stationed? _____Yes ____No

______Carts (on call) Always available? _____Yes ____No

______Computer Lab. Permanently stationed? _____Yes ____No

______Other_______________________________________

13] Is there an expectation by middle or junior high school staff that your students will have achieved a specified range of instructional computing experiences? Yes_____No______

14] What percentage of your students use a computer at least

_______% 15 Min., but less than 30 min., per week?

_______% A half hour, but less than one hour, per wk.?

_______% one hour or more per week?

15] When students formally learn <u>about</u> the computers, are learning outcomes measured and/or recorded?

_______Yes _______No _______Sometimes

16] Are students in any of the following categories provided computing time? (Check any that apply.)

__________Gifted/talented _____Special education

__________Chapter I ? _____Other?

17] Are computers used to teach instructional objectives in <u>several</u> curricular/instructional areas? _____Yes _____No

18] Which of the following instructional uses of computers and which computer languages are evidenced in your school? (Please check all that apply.)

_____Word processing/applications _____Tutorials _____Drill

_____Simulation _____Library Skills/Data base search, etc.

_____LOGO _____BASIC _____Other programming languages

_____Math. _____Language Arts _____Music, Art

_____Reading _____Science _____Social Studies

_____Prob.Sol. _____Decision Making __________Other...

19] In addition to student instructional uses of computers, are any computers dedicated to other purposes in your school? _____Yes _____No.

If "yes," __________total number so dedicated.

And, if "yes," are computers used for:

Computer-managed instruction? _____Yes _____No.

School administration? _____Yes _____No.

20] How many pieces of instructional software are in your school's collection?_____0 ______1-25 _____26-50

_____50 or more diskettes or tapes._____Don't know.

21] Is there a district-level commitment to ongoing purchases or financial support for: (Please check all that apply).

________Computer hardware?

________Computer maintenance?

________Instructional software for students and teachers?

________Teacher training and technological updating.

22] Has your school either developed its own, or does it follow a district-developed long-range plan encompassing educational objectives for instructional computing? ______Yes ______No

23] Since September of 1981, what percentage of your teachers have received <u>district</u>-sponsored or funded inservice training in:

_____% Introduction to computing?

_____% Evaluating instructional software?

_____% Managing computers in the classroom or lab.?

_____% Instructional applications of microcomputers?

_____% Any programming languages?

24] For teaching <u>about</u> and <u>with</u> computers, what percentage of your instructional staff do you <u>perceive</u> as:

________% Highly or somewhat qualified?

________% As yet, not qualified?

25] Is there a <u>district</u>-wide computer consultant?

_____Yes _______No. If "Yes," Does The Consultant do any consulting with your staff and/or students?

_________Yes ________No

26] Is there a building 'expert' either certifed or non certified who volunteers or is paid to assist teachers, staff, or students with instructional computing?

________Yes ________No

27] Is there an ISD computer consultant regularly available to teachers? ______Yes _______No

28] Do you perceive that there is a general enthusiasm and/or support for learning with and about computers exhibited by

Students? ____Yes ____No ______Don't know

Teachers? ____Yes ____No ______Don't know

Parents? ____Yes ____No ______Don't know

Dist.Adm? ____Yes ____No ______Don't know

29] Other than Intermediate School Districts, is your school networking or sharing resources to enhance educational computing? ____Yes ____No ____Don't know.

<u>Please note</u> : Additional comments are appreciated.

For example: Is your school developing an instructional plan, or hiring a computing consultant?

[If the enclosed envelope is misplaced, please mail the completed questionnaire by April 18, 1985, to:

Bancroft/Lezotte, Dept. Ed. Adm., 418 Erickson, Michigan State University, East Lansing, MI 48824

Phone 517-353-9024]

SAMPLE OF OPINIONNAIRE
SENT TO EDUCATIONAL COMPUTING EXPERTS
JULY, 1984

TO:___

___

___

Dear Colleague:

I am asking for your assistance as one who is an expert in the area of instructional or educational computing. Your responses will be utilized as items on a short questionnaire to be distributed to all Michigan public school districts. There are three stages of study to be included in my dissertation. The first phase will seek to identify schools where there is present the attribute of high access and participation provided for students to engage in instructional computing activities.

Please use your personally derived definitions for the terms "high access and participation" and for "instructional computing activities". As you think of a school which might evidence these components, please list at least 5 (five), but no more than 7 (seven) characteristics (those which come quickly to your mind) which you believe would be present in a school, or in a school district, where students experience high access and participation in instructional computing activities. If you wish to rank the items, please use "1" (one) to represent the most essential characteristic.

Thank you for your assistance. If you are interested in an abstract or summary of the study in progress, please initial above. Your name will not appear in relation to the items which you provide below. Your assistance will be acknowledged. Please complete this rapidly and return in the envelope provided. Your first thoughts are desired.

+++++++

CHARACTERISTICS PRESENT IN A SCHOOL (OR SCHOOL DISTRICT) WHERE STUDENTS ARE PROVIDED WITH HIGH DEGREES OF ACCESS TO COMPUTERS AND HIGH DEGREES OF PARTICIPATION (OR USE) OPPORTUNITIES WITH COMPUTERS AND INSTRUCTIONAL COMPUTING ACTIVITIES. (EXAMPLE: funding commitment).

1. school board commitment to concept & funding
2. community demand
3. administrative support, encouragement
4. principal involvement & leadership
5. adequate number of computers per pupil
6. district & bldg. leadership on staff eg. media specialist.

SITE SURVEY INSTRUMENT TEACHER INTERVIEW

SCHOOL DISTRICT NAME__________________________________

SCHOOL NAME__________________________

TEACHER INTERVIEWED______________________________

GRADE____________________ DATE______________________

GRADES SCHOOL SERVES K 1 2 3 4 5 6

GRADES WHICH HAVE MICROCOMPUTING INSTRUCTION
K 1 2 3 4 5 6

SPECIAL GROUPS SCHOOL SERVES

RATIO OF ALL STUDENTS IN SCHOOL TO ONE (1) COMPUTER

CONTEXT AND SUPPORT

How would you characterize your attitude toward microcomputers?

1=_____negative 2=______slightly negative 3=______mixed
4=_____slightly positive 5=________positive.

Do you have a personal computer at home?

________Yes ________No

How did you get started using microcomputers in instruction?
(Please check one)

____1. Impetus from district administration or school board.
____2. Impetus from school administration e.g. principal
____3. Own initiative
____4. Other
____5. Don't know

(Please explain)

In your estimation, how would you characterize the level of enthusiasm fro instructional computing in your school community by: (Please circle one for each category).
1=___Negative 2=___Slightly negative 3=___mixed
4=___Quite poisitive 5=___Actively positive
6=___Don't know.

Teachers	1	2	3	4	5	6
Students	1	2	3	4	5	6
Principal	1	2	3	4	5	6
Other school staff	1	2	3	4	5	6
Dist. Administration	1	2	3	4	5	6
Parents	1	2	3	4	5	6
Other (e.g.counsellor)	1	2	3	4	5	6

As far as continuing support for using computers in teaching,
What support for your microcomputer use is routinely provided?
Please circle one only.

1. None
2. Technical support
3. Technical support and financial support
4. Financial support only
5. Don't know.

IF SUPPORT IS PROVIDED:
How adequate is the level of support provided?

1=___not at all 2=___minimally adequate 3=___adequate
4=___more than adequate 5=___extremely adequate
6=___not applicable

IF SUPPORT IS PROVIDED:
Describe nature of support, (e.g. computing consultant, time to plan).

IF SUPPORT IS PROVIDED:
Does it derive more from the ____local school district or
____the district?
(Please check only one.)

What kinds of technical or financial support service would the respondent like to see?

Staff Development

Is staff development or training provided by the district?

_____Yes _____No _____Don't know.

IF SUPPORT IS PROVIDED: Check any topics below that apply to staff training with instructional computing:

______Introduction to computing?

______Evaluating instructional software?

______Managing computers in the classroom or lab?

______Instructional applications of microcomputers?

______Any programming languages?

______Other, please describe.

IF STAFF DEVELOPMENT IS PROVIDED: Did the respondent participate in any of the staff development opportunities above:

_____Yes _____No _____Not applicable.
(If YES, please circle any of topics above in which the respondent participated.)

IF TEACHER PARTICIPATED: List the topics most helpful.
1.
2.
3.
least helpful.
1.
2.
3.

IF SUPPORT IS PROVIDED RFOR MICROCOMPUTING STAFF DEVELOPMENT,
Is it ongoing?
_____Yes _____No _____Don't know.

IF STAFF DEVELOPMENT SUPPORT IS <u>NOT</u> OR IS ONLY PARTIALLY PROVIDED BY THE DISTRICT OR SCHOOL,
Please describe what training you obtained and where you were able to obtain training.

<u>Ideal inservice training programs</u>

a. Should the following content areas be covered in inservice training programs? 1= Yes 2= No 9= not mentioned by respondent.

1. Programming	1	2	9
2. Operation of the microcomputer	1	2	9
3. Selection/evaluation of courseware	1	2	9
4. Instructional uses of microcomputers	1	2	9
5. Administrative uses of microcomputers	1	2	9
6. Integration of microcomputers w/instruction	1	2	9
7. Computer literacy	1	2	9
8. Others	1	2	9

b. What other features should be included in the ideal inservice training?

Location:

Length:

Organizational incentives:

Leadership:

Parents and Community:

Other

Should the content of <u>preservice</u> training programs differ from the inservice training programs? 1=___Yes 2=___No 9=___Don't know.

IF YES, Please describe:

<u>Student and classroom and related usage</u>.
Users:

Who are the computer users in your school? Please check <u>any</u> that apply.

______Teachers. If so, what percnet of F.T. Staff ____%

______Students. If so, what percent of all students ____%

______Secretary.

______Principal

______Parents

______Support staff - Name:

______Other

Student characteristics:

Average number of students in your class. ________

Approximate percentage of minority students. _______%

Approximate percentage of males _________%

Ability level of students. _____Low _____Mixed _____High

Socio economic level of class. _____Low ___Mixed ____High

_________% Please estimate the percentage of students in your class who have a computer at home.

Applications:

Which of the following instructional applications are used by the teacher with the students? (Please check all that apply):

_____Work processing/applications ___Tutorials ____Drill

_____Simulation ___Library skills/Data base search, etc.

_____LOGO ____BASIC ________Other programming lang.

_____Math. _____Lang. Arts. _____Music, Art

_____Reading _____Science _____Social Studies

_____Problem Sol. ____ Dic. making _____Other, (e.g. microworlds, games, please list).

Does the respondent mention any goals for microcomputers in its own right? (e.g. literacy or enrichment.?

_____Yes _____No _____NA

<u>Local or district goals and objectives</u>:

Does your district or school have a written policy and /or an instructional plan for educational microcomputing which is curriculum related , as well as use related?

_____yes _____No _____Don't know.

Please name the major content areas you cover with your class:

How extensively is the microcomputer used with the curriculum content you have just named?

1=_____Not at all 2=_____very little 3=____often
4=_____Extremely often 9=_____Not applicable.

In your classroom, for what major topics IS the computer used?

To what extent do you perceive that the computer instruction is COORDINATED with other instructional activities? (e.g. texts, labs, dittoes).

___1 ___2 ___3 ___4 ___5 ___9

In the respondent's judgement how well INTEGRATED are microcomputer activities and "regular" instruction?
..In the classroom? ___1 ___2 ___3 ___4 ___5 ___9

..In the school? ___1 ___2 ___3 ___4 ___5 ___9

How much does the respondent stress or emphasize these goals and objectives for his/her students in the subject matter?

1=___not at all 2=____extremely 9=____not applicable

1. Mastery of essntial skills __ 1 ___2 ___3 ___4 ___5 __9

2. Acquisition of higher cognitive skills?
___1 ___2 ___3 ___4 ___5 __9

3. Motivation? ___1 ___2 ___3 ___4 ___5 __9

4. Classroom management? (i.e. orderly work environment, student cooperation or teamwork.)
___1 ___2 ___3 ___4 ___5 __9

5. Other (s) ___1 ___2 ___3 ___4 ___5 __9

How <u>successful</u> has microcomputer use acutually turned out to be with respect to the goals and objectives established for its use?

1=____Not successful; 4=____Highly successful; 9=____NA

____1 ____2 ____3 ____4 ____9

<u>Allocation of time</u>

How many minutes per week does the respondent use the microcomputer as a teaching aid?

__________minutes per week.

How many minutes per week does the respondent use the microcomputer in all school related tasks?

__________minutes per week.

How many minutes per week does each student typically spend working with the microcomputer for instruction and enrichment?

__________minutes per week.

<u>Locations</u>

Where are the microcomputers located in yor school?

________Classrooms permanently stationed? ____Yes ____No

________Media Center permanently stationed? ____Yes ____No

_______Carts (on call). Always available? ____Yes ____No

_______Computer lab. Permanently stationed? _____Yes ____No

Does the arrangement, location, and access to the available computers seem to be the most effective possible?

_____Yes _____No _____Don't Know.

If, "NO" what changes have you made or would you make to provide greater access or efficient use by more students?

<u>Hardware</u>

What computer hardware, besides a monitor and computer keyboard is available to you for teaching purposes?

Are any outcomes measured which are concerned with students learning with and/or about computers?

____Yes _____No _____NA

If "Yes," Please describe how it is done.

How are students grouped for computer activities, primarily?

1= individually; 2= pairs; 3= in groups of three or more; 5= varies with activity; 9= Not applicable.

_____1 _____2 _____3 _____5 ______9

Are all students within your class allocated just about equal time with computers?

______Yes ______No ______Don't Know.

If, "No," Please describe how time is allotted.

Are there constraints put on the use of certain computers in your school because of dedicated use caused by funding?

_____Yes _____No _____Don't know.

If "Yes." Please describe what funds or designations limit the use. (For example, Chapter I, or School Administrative uses only.)

<u>Courseware</u>

Does the respondent select the courseware s/he uses in instruction?

_____Yes _____No _____NA

What is the primary source from which the teacher obtains courseware?

_____District or school

_____On own or from teacher/computing journals

_____Authors or writes it.

_____NA

IF TEACHER SELECTS COURSEWARE

What features does the teacher look for?

What features does the teacher avoid?

Does the district/school have standard criteria for evaluating courseware?

_____Yes _____No _____NA

Briefly, how could courseware be improved?

Does the respondent make use of the microcomputer for any of the following non-instructional purposes?

a. Student record keeping?	_____Yes	____No
b. Testing students?	_____Yes	____No
c. Other?	_____Yes	____No

Miscellaneous Opinionnaire

What personal or professional resources or assistance would be most valuable to the respondent in enhancing the instructional uses of computers of his/her students?
(Consider help that might be arranged by the Intermediate School District, State Department of Education, a local university or collоge, or the community)

1.
2.
3.
4.
5.

What characteristics do you believe need to be present if students in a school are to be assured a high degree of availability of microcomputers and a high degree of access and participation?

1.
2.
3.
4.
5.

Does the respondent perceive that microcomputers have changed the way teachers teach?

____Yes ____No ____Don't know.

Explain, if you wish.

Does the respondent feel that microcomputers have changes the way students learn?

____Yes ____No ____Don't know

What person (please give role) has been most helpful and motivating to you in the positive and enlarged uses of instructional computing?

If you are a local school computer "buff" or "expert," what challenges, pressures, or pleasures does that create for you as you fulfill other instructional duties?

List any advice you have for getting the school district more involved with computers.

List any advice you would have for getting teachers more involved with computers.

Please list any instructional or networking (sharing with other schools, etc.) ideas that have been successful in improving isntruction or varying alternaitves for learning as a result of you microcomputer use?

What essential skills do you believe have a priority for students in your class? or school?

From you experience and personal definition of the term "computer equity," what characterizes your specific effort to assure for students equitable instructional computing opportunities?

How do you rank the importance of introducing and using computers with elementary students?

1= ____Not 5= ____Very

____1 ____2 ____3 ____4 ____5

Prepared for teacher interviews at selected school sites. Beverly A. Bancroft, Michigan State University, East Lansing, Michigan,(c) 1985.

SURVEY FOR DISTRICT COMPUTER CONSULTANT OR ADMINISTRATOR

Name____

School Dist. Name.____

Date ______________________Phone (   )__________________

1.____________Number of schools in district

2.____________ Elementary __________Middle/JH ______SH

3.________Number of students in district. Number of teachers in district.___________________

4.________Approximately how many computers in district are dedicated to educational computing? ______In Elem. Schools?

5.________Approximately how many computers in district are dedicated only to teacher inservice? ___________to computer managed instruction?

6.________Approximately how many microcomputrers in the district are dedicated to school administration? (Exclude central office.)

7. Is there a district level commitment to ongoing purchases or financial support for: (Please check any that apply.)

__________Computer hardware?

__________Instructional software for students and teachers?

__________Computer maintenance?

__________Teacher training and technological updating?

__________Full-time computing constultant?

__________Part-time computing consultant?

8. What funding sources are there for your computing needs district wide? (Please check all that apply.)

___________District contingency fund?__________School individual discretionary fund?

___________Bond issue for equipment, etc? __________ Special millage proposal?

_________Board/District funding commitment long-range?

_________Board/District funding commitment short range.

_________Individual school fund raising activity.

_________Grants from private foundations or business or community effort. (Please describe, if applicable.)

__________PTA/O or other parent organization.

__________Chapter II funds. ________Article III Funds.

__________Chapter I funding. ________ Part B of the Education Handicap. Act P.L. 42 142. _____Other.

Student/Community Characteristics

9._____%Approx. percentage of minority students in district?

10. Estimated ability level of students.

_____Low ________Mixed _______High-

11. Estimated socio economic level of students.

______Low ________Medium ________High-

12.________% percentage of students you estimate would have access to a computer at home.

13. Are any computers dedicated to special uses only?

______________Yes ____________No

If Yes, please explain.

14. What is the official title of the consultant?

____

15. Is there a position description?

___________Yes ____________No (Please attach).

15. (a) Please list any coursework which prepared you for this position.

(b) Please name any coursework subsequently taken which improved your understanding of this position.

16. Are district goals established for instructional uses of computing K-12.

____________Yes ______________No

17. Are district policies in place for distribution and use of microcomputers across grades and across groups?

____________Yes ___________No

18. Is there a district computer advisory committee representing the program and planning development?

____________Yes ____________No. If Yes, please comment.

19. Does each school have a computing advisory committee?

________Yes _________No

Please discuss, if helpful

20. Does each school or do some schools have a school plan for instructional computing which is designed for the school alone?

__________Yes __________No.

21. Please discuss how you view the similarity of approach across school sites in the development of training, software, hardware, use, and participation by students and teachers. Please include: Elementary , Middle, Secondary

22. Since 1981 what percentage of your teachers have received school district sponsored or funded inservice training in:

____________% Introduction to computing

____________% Evaluating instructional software?

____________% Managing computers in the classroom or lab.?

____________% Instructional applications of microcomputers?

____________% Any programming languages?

23. For teaching with and/or about computers, what percentage of your instructional staff do you perceive as:

____________% Highly or somewhat qualified

____________% Not qualified as yet.

24. If teachers are at various stages of using microcomputers in instruction, and were not district trained, how did they obtain the expertise they have?

25. What do you as consultant spend most of your time doing?

26. What are your personal priorities for this position--your vision? i.e. What do you believe you need to do to reach the goal you believe is most important for students with instructional computing at the

Elementary

Middle

High School

27. What are the impedences you perceive in a more fully developed instructional computing opportunity for students and teachers?

[1.____________________

[2.____________________

[3.____________________

28. What characteristics do you believe have to be present in a school or system to facilitate the maximum availabilty and participation of students and teachers with microcomputers?

[1.

[2.

[3.

[4.

[5.

29. Please rank the above in importance with: 1, 2, 3. 4, or 5.

30. How do you believe instructional computing got its start in your school system?....

At the elementary level?

At the middle school level?°

At the high school level?

31. How important do <u>you</u> believe computer awareness, access and appropriate use is to elementary students?

1=___________Not important to 5= very important.

____1 ____2 _____3 _____4 ______5

32. From the first survey conducted, it was noted that many school staffs are very concerned about providing and assuring access and participation of students and teachers with instructional computing opportunities............

How might the following agencies be of assistance, in your view, with advancing this cause?-

--The Michigan Department of Education

--The Local Intermediate School District?

--Your district or in concert with others?.......

--Other?

32. What do you believe is appropriate content for elementary students, when the number of computers and the amount of software for a given school is severely limited?

33. Are you sharing resources or ideas with any other school or district or computer user or user group?

___________Yes ____________No

Please explain, if yes.

34. Other schools are interested in ideas for adding to their computing resources, or innovative ways to use computers to stretch their use to more students and groups?

Please describe any grass roots efforts which have helped you.

35. Describe the microcomputing staff development process.

36. Do all your schools seem to have an on-site computer expert? __________Yes __________No

37. Please describe this person°s (s') impact or influence.

38. What is your viewpoint of how computers should be ultimately

used in schools by students?

by teachers?

by administrators?

by parents?

39. Do parents or does community support influence the depth you instructional computing program effort?

__________Yes __________No __________Somewhat

Please describe, if Yes.

Time precludes an indepth discussion. Some of your comments have answered the inquiries at other points during this interview. However, a few items need to be addressed so that you may comment for the help it might be to other consultants, and to professionals who develop a program without the assistance of a consultant.

Please comment on the following:

40. What level of implementation do you believe your district is experiencing in the change process?

Cory, (Computing Teacher, November, 1983, p. 11-16) names the following. _________Getting on the bandwagon

_________Stage of confusion

_________Stage of pulling it all together

_________Stage of full implementation

_________Stage of still considering whether to get started. Cory describes these stages, as well, by focus: Hardware, Software, Staff Development, Computer-Assisted Learning; Computer Literacy and Attitude; but in general terms, where is your district?

SURVEY FOR A MICHIGAN ELEMENTARY SCHOOL PRINCIPAL, INSTRUCTIONAL COMPUTING SURVEY II, 1985

The interview questions include the following topics: 1) Access and availability of computer related resources; as well as student and school demographics not collected on initial survey; 2) Applications and utilzation for students and staff; 3) Policy and funding decisions - for example - school level, vs. district level; parent/community involvement; priorities such as consultant; distribution of resources; 4)Level of integration and implementation of the innovation; 5) Teacher training and staff development; identification of "experts" or "buffs;" and, 6) Attitudes and opinions.

Name____

School and Dist. Name______________________________

/______________________Phone________/_______________

__________Number of Schools in Dist? _____No. Elem?

__________Number of computers in school?

_______Number dedicated to educational computing?

_______Number dedicated to school administration?

______ Number dedicated to computer managed instruction?

1. _______% Aproximately what percentage of your students use the microcomputer once a week?

2. _______% Approximately what percentage of the teachers in your school use the microcomputer once a week?

3. _______ At what grade level do your students receive their first formal instruction with microcomputer usage?

4. What grades does the school serve?

____K ____1 ____2 ____3 ____4 ____5 ____6

5. What grades receive instruction in all grades served?

_____K ____1 ____2 _____3 ____4 ____5 _____6

6. During the regular school year, or in the summer, are there any clubs or groups of students who have access to school computers?

___________Yes ____________No, If yes, please describe

7. Are there any computers limited in use to certain groups of students or teachers because of dedicated funds?

_____________Yes ______________No,

8. Please check any of the funding sources below which are utilized by your school.

_______Chapter I _______P.L. 42-142 _____Chapter II

______ Article III _______Other, (If other, please describe:)

________Computer mangaged instruction teachers only.

________School administration, staff only

________Gifted/Talented ________Other

9. Other than computers dedicated because of outside funding, are any groups of students given more computer time than others?

__________Yes ____________No, If Yes, please explain.

10. ______________%What percent of your students would you estimate have access to a computer at home?

11. _________Low _________Mixed __________High

↑ Please indicate the ability/achievement level of students in your school?

12. _________Low _________Medium ___________High

↑ Please estimate the socio economic level, generally, of your students.

13. _________% Please estimate the percentage of minority students in your school?

14. ________%_Please estimate percent of teachers in your school who have a computer at home?

15. Have you used the physical location of microcomputers to encourage computer use by teachers?

_________Yes _______No If Yes, please describe:

16. Where are the computers located at present?

17. Are any computers stationed in general education classrooms permanently? ___Yes ____No

Special education or other _______Yes ________No

If Yes, please describe

18. Which of the following instructional uses of computers and which computer languages are evidenced in your school? (Please check all that apply.)

______Word Processing/applications _____Tutorials ____Drill

_____Simulation ____Library Skills/Data Base Searches

_____LOGO ____BASIC _____Other programming languages.

_____Math ______Lang.Arts_____Music, Art.

_____Reading _____Science _____Social Studies

_____Problem Solving ___Decision Making

______Microworlds __________Literacy __________Other, please describe

19. _____% Percent of time all computers are used for instructional purposes.

20. In the respondent's judgement, how well integrated are microcomputer activities with regular, ongoing instruction?

1= Not integrated; 4= Highly integrated; 9= Don't know

1 2 3 4 9

21. How much experience has the respondent had with computers?

1=Not at all; 2= a little 3= some 4= a great deal.

1 2 3 4

22. How would you characterize your attitudes towards computers in education?

1=Negative; 2= slightly negative; 3= Mixed or neutral

4= Slightly positive; 5= Positive

1 2 3 4 5

23. Which individuals in your school teach others about or how to use computers? (Please check any that apply.)

_______ Administrators; ____Teachers _______Paid Aides

_______ Media Specialist ____Volunteers _____Students

_______ Other School Staff __________Other

Please describe "other."

24. Do you have a computer expert in your school, or a "buff?"

__________Yes _______No. If yes, have they been influential in promoting a high degree of participation beyond their own classroom? ________Yes _________No

Desrcibe postive or problematical aspects, please, if Yes.

25. Are there expectations at the middle/junior high school that your students will have achieved a specified range of instructional computing experiences?

__________Yes __________No

26. Do you perceive that there is a planned instructional transition for elementary students, which builds on their instructional computing understanding and experience?

______________Yes _______________No ____Don't know.

27.Does your school have specific timetables for imp lementing computer based systems and/or curricula?

______________Yes ______________No ______Don't know.

28.Do you have a catalog of available computer software in your school? ____Yes _________No _______Don't know.

29. Who uses the computer in your school?

(Please check all that apply.)

_____Principal ____Teachers ____Special computer

personnel ____Counselors ____/Secretaries, clerks;

Students _____Other.

30.What training have you had as an administrator in using computers? Please list and describe.

______________School or District sponsored

______________Self-initiated

31. At the beginning, how did microcomputers come to be used in your district? (Please check one).

a. Administrative decision in the district

b. Administrative decision in the school.

c. Combination of administrative & grass roots.

d. grass roots or bottom from teachers.

3. Other, if other, please describe.

32. To what degree did each of the following support or resist the Introduction and Implementation of microcomputers?

1= resisted strongly; 2= resisted somewhat; 3- neutral or mixed 4= supported somewhat; 5= supported strongly

9= no information.

a. District administrator	1	2	3	4	5	9
b. Principal	1	2	3	4	5	9
c. Teachers	1	2	3	4	5	9
d. Parents	1	2	3	4	5	9
e. Other(s). Please describe	1	2	3	4	5	9

33. What reasons were given for supporting the implementation of student computer use in your school?

34.How influential are the following persons or groups in terms of deciding what computer-related courses are to be offered to students?

Group	Very influential	Influential	Not
Supt./Board	o	o	o
Principals	o	o	o
Computer cons./spec.	o	o	o
Teachers	o	o	o
Parents	o	o	o
Supervisors	o	o	o
Local business	o	o	o
Students	o	o	o
Other	o	o	o

35. What mechanics have been put into operation for parents to become knowledgeable about computers and to be informed about what their children are doing? (Check any that apply.)

____ Parent/teacher meetings and demonstrations

_____Parent/student workshops

_____Other, if other, please list.

36. For which of the following items are there budgets established in your school or district.

	School	District
Hardware , etc.	o	o
Software	o	o
Teacher training	o	o
Ongoing staff dev.; tech. change	o	o
Maintenance, repl.	o	o

37. Has there been any resistance to the introduction of microcomputers in your school? _____ Yes ____No.

If Yes, please describe roles of those involved, or events.

38.If you have a computer consultant in your district, what is your understanding of the role?

1.______________________

2.______________________

3.______________________

4._NA

39. Please rank your perceptions of which roles are most to least important.

40. Do you have a local and ongoing computer planning committee? _________Yes _________No

41. Does your district have an ongoing computer planning committee? __yes ____no.

(Composition?)

42. Describe any efforts to attain computer equity both in your school and across the district.
Use your interpretation of equity to speak to this issue.
Optional

43. Does your school and do you as principal have any discretionary funds for computer related purposes?

44. Does your school ______yes ________no
have written goals for students' learning outcomes with instructional computing?
district? ______yes ________no

45. Is there a strategy for procurement of resources and attainment of instructional goals?

_______Yes __________No.

If Yes, has progress been made?

______Yes ______No ___ Somewhat less than anticipated.

46.________During what school year did your <u>district</u> make its first policy decisions about acquisition of microcomputers, implementing goals and objectives for instruction?

47.At the present time, what are your school's major <u>goals</u> for microcomputers in instruction?

Time precludes an indepth disscusion. Some of your comments have already answered inquiries in previous sections of this interview. However, a few items need to be addressed so that you may comment for the help it might be to other schools and districts.

Please comment on the following:

48. What level of implementation do you believe your district and school are experiencing in the change process?

Cory, (Computing Teacher, November, 1983, p. 11-16) names the following:

(Cory applies them to these areas: Hardware, Software, Staff Development, Computer-Assisted Learning; Computer Literacy and Attitude). Where do you perceive your school and district now to be in these stages of implementation, across the spectrum?

SCHOOL (Please check only one in each column) DISTRICT

________Getting on the bandwagon. ________

________Stage of confusion ________

________Stage of pulling it all together ________

________Stage of full implementation ________

________Stage of considering whether to get started ______

49. How do you view the need for developing and maintaining an attitude about CHANGE for yourself and your staff and students in view of the new technologies.

50. Gene E. Hall (The Journal of Computers in Mathematics and Science Teaching, Winter, 1981, page 14-29) describes the typical expressions of concern about an innovation such as microcomputing. Please check the one which fits your school. Please check the one which you believe fits your district.

School	District	
______	________	0=I am not concerned about it.
______	________	1=I'd like to know more about it
______	________	2=How will using it affect me?
______	________	3=I seem to spend all my time getting materials ready.
______	________	4=How is it affecting students?
______	________	5=I'm concerned about relating what I'm doing with what other instructors are doing.
______	________	6=I have some ideas about something that would work even better.

0= Awareness; 1= Informational; 2= Personal; 3= Management; 4= Consequence; 5= Collaboration; 6= Refocusing.

---

51. Have you found it necessary to employ efforts or strategies to redefine your preparation in light of technological or organizational change.?

_________Yes __________No . If yes, please describe.

52. From your experience with using computers in teaching and learning, which of the following have you found to be a disadvantage. (Please check any that apply.)

__________Lack of access to terminals or microcomputers.

__________Lack of student interest.

__________Low quality of educational software.

________Reallocation of funds to computers from more pressing needs.

________Difficulty with integrating computer taught skills with the remainder of the curriculum.

________Lack of teacher or staff training

________Lack of teacher or staff interest

________Lack of administrative support

________Other, please describe.

54. ____________% What percent of your computer using teachers/staff would you estimate have obtained most of their computer knowledge because of personal interest and investment of personal time.

55. Is professional assistance or are resources routinely provided to your school by the <u>district</u> to support computer using teachers? ___Yes ___No. (Please discuss).

____________Technical?

____________Funding?

____________Continuing Inservice?

____________Material Resources

____________Please check any that apply.

56. How satisfied is the respondent with district staff development training? (1=not satisfied; 4= extremely satisfied; 9= no training provided, not applicable.

1 2 3 4 9

1 2 3 4 9

57. How satisfied is the respondent with on-site teacher training? 1 2 3 4 9

Please describe in either case, which were satisfying and might transfer to other sites.

58. Since September of 1981, what percentage of your teachers have received district-sponsored or funded inservice training in

________%Introduction to computing?

________%Evaluating instructional software?

________%Managing computers in the clasroom or lab.?

________%Instructional applications of microcomputers?

________%Any programming languages?

The respondent the above question on Survey I. It is repeated here, so that comments may be made on other means by which these offerings might have been obtained. In addition,

________%Computer literacy and societal implications

________%Student learning-re: the technologies

________%Others - (such as special education----etc.)

59.______% What percentage of your teacher, who are expected to be involved with instructional computing in your school appear to be "somewhat" or "highly qualified" to do so?

(Please estimate).

60. What are the instructional priorities in your school?

1.

2.

3.

Please describe how instructional computing fits into them.

61. To what extent have microcomputers affected the way students learn, in the respondent's judgment?

1=Not at all; 4= A great deal; 9= No information.

1 2 3 4 9

62. What, if anything, do you believe impedes a fuller degree of <u>instructional computing</u> use across grades, instructional groupings, among boys and girls, or among students at varying achievement levels.

1.

2.

3.

4. Not applicable.

63. What, if anything, do you believe impedes a fuller degree availability of microcomputers and computer-related resources?

1.

2.

3.

4. Not applicable.

64. What, if anything do you believe impedes more use by all teachers, of instructional computing opportunities for students?

1.

2.

3.

4. Not applicable.

65. Given the many issues in education today, and a principal's responsibility to "take advantage of the opportunities presented by this new technology without disrupting organizational stability," what importance do you assign to offering elementary students what you and your staff and local school community deem to be appropriate instructional computing experiences?

1= not important; 2= minor importance; 3= somewhat important 4= important 5= major importance.

1 2 3 4 5

66. List 3 suggestions which, if offered and accepted by the district Board and administration would lead to a fuller, richer, and more integrated learning experience for students and teachers.

1.

2.

3. 4. Not applicable

67. ....In a like manner, the Intermediate School District.

1

2

3 4. Not applicable

68. In a like manner, the State Department of Education.

1

2.

3.

69.Do you have any advice for getting teachers more involved with instructional computing?

70.Based upon your experiences and observations with educational computing, what recommendations would you make about how courseware could be improved and more useful to teachers.

71.Do you believe that computers have affected the way students learn? _____Yes _____No ___Don't know.

72 Have you observed that computers affect the way teachers teach? _____Yes ____No ____Don't know.

73. Do you have any suggestions of how universities, colleges, community colleges or community education could assist with computer education in public schools?

74. Does your curriculum have a cycle of review, evaluation, monitor and adjust which adapts to change? That is, throwing out what isn't working or is obsolete, and implementing more promising practices?

___Yes ______No ________Don't know.

75. What characteristics would be present, in your view, in a school or district which provides a high degree of availability of microcomputers and high participation opportunities for its staff and students? (Please list 5-7).

SELECTED BIBLIOGRAPHY

SELECTED BIBLIOGRAPHY

Acker, Stephen R., and Klein, Elisa L. "Visualizing Spatial Tasks: A Comparison of Computer Graphic and Full-Band Video Displays." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Action Research Roundup. Classroom Computer News 1 (September/October 1981): 18-20.

Agresto, John. "Technology and the American Dream." Paper presented at the North Carolina Educational Association, 1981.

Ainsley, Lucy E. "Educational Technology and Basic Skills." Michigan School Board Journal 29 (April 1983): 10-12.

Allen, Anthony James. Computer Courses for Adults: Anxious Human Meets Computer: A Resource Book for Instructors. Eugene, OR: International Council for Computers in Education, 1984.

Allen, Camille Ann. "An Analysis of the Social Interactions Among a Teacher and a Small Group of Students Working With Microcomputers." Ph.D. dissertation, University of Connecticut, 1984.

Alvarado, Anthony J. "Computer Education for All Students." The Computing Teacher 11 (April 1984): 14-15.

American Association of University Women. "Computer Education: Terminal Inequity?" Graduate Woman 79 (April 1985): 10.

Anderson, John J. "Prediction and Predilection: Creative Computing and the Future of the Micro Industry." Creative Computing 11 (November 1984): 52.

Anderson, Ronald E.; Welch, Wayne W.; and Harris, Linda J. "Inequities in Opportunities for Computer Literacy." The Computing Teacher 11 (April 1984): 10-12.

Association for Supervision and Curriculum Development. "Computer Integration Into Instruction Is Stuck; Experts Blame Unclear Optimal Uses and Three Implementation Problems." ASCD Update 27 (Summer 1985): 1, 6-7.

Bancroft, Beverly A. "How Three Public School Systems in Southeastern Michigan Integrated Microcomputers Into Their Instructional Programs." Unpublished field-based research for the Ed.S, Eastern Michigan University, April 1983.

________. "The Microcomputer: One Versatile Tool for the Middle School Learner." Michigan Middle School Journal 8 (Fall 1983): 7-8.

Becker, Henry Jay. "Computers in Schools Today: Some Basic Considerations." American Journal of Education 93 (November 1984): 22-39. (b)

________. "Cost vs. Effectiveness: Roles of Microcomputers in Education." NASSP Bulletin 6 (September 1982): 50. (b)

________. Microcomputers in the Classroom: Dreams and Realities. Baltimore, MD: Center for Social Organization of Schools, Johns Hopkins University, 1982. (a)

________. School Uses of Microcomputers: Reports From a National Survey. Survey Issue Nos. 1-6. Baltimore, MD: Center for Social Organization of Schools, Johns Hopkins University, April 1983-November 1984. (a)

Berman, Louise. "Educating Children for Lifelong Learning and a Learning Society." Childhood Education 61 (November/December 1984): 99-106.

Billings, Rolland G. "Videodisc Technology in Education." Michigan School Board Journal 29 (April 1983): 13.

Boger, Robert P.; Bloom, Buston E.; and Lezotte, Lawrence W. (eds.). Child Nurturance: An Agenda for the 1980's. New York: Plenum Press, 1984.

Bork, Alfred. "Computer Futures for Education." Creative Computing. 11 (November 1984): 178-80. (a)

________. "Computers in Education Today--and Some Possible Futures." Phi Delta Kappan 6 (December 1984): 239-44. (b)

Boyer, Ernest. "Effective Schools and How They Work." Cited in News From the Office of Congressman Augustus F. Hawkins. California 29th District, Fall 1984.

________. High School: A Report on Secondary Education in America. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching, 1983.

Brookover, Wilbur B., and Lezotte, Lawrence W. "Educational Equity: A Democratic Principle at the Crossroads." The Urban Review 13(21) (1981): 65-71.

Brophy, Jere, and Hannon, Patrick. The Future of Microcomputers in the Classroom. Occasional Paper No. 76. East Lansing: Institute of Research on Teaching, Michigan State University, 1984.

Brumbaugh, Kenneth. "Reflections on Educational Computing." Creative Computing 10 (November 1984): 172-73.

Buffie, Edward G. "Accountability: The Key to Excellence." Childhood Education 61 (November/December 1984): 107-14.

Burleigh, Joan. "For Microcomputers: Effective Inservice Training." Michigan School Board Journal 29 (April 1983): 19, 27.

________. "Scheduling for Instructional Computing in an Elementary School Environment: A Planning Model." Staff presentation, Birmingham, Michigan, Public Schools, April 1985.

Burns, P. K., and Bozeman, W. C. "Computer Assisted Instruction and Mathematics Achievement: Is There a Relationship?" Educational Technology 21 (1981): 32-39.

Caldwell, Janet. "Computers and Achievement Directed Leadership." Instructional Improvement News 4 (Winter 1983/4): 6.

Calfee, Robert. "Computer Literacy and Book Literacy: Parallels and Contrasts." Educational Researcher 14 (May 1985): 8-13.

Cardenas, Jose A. "High Tech and Equality of Opportunity." Intercultural Development and Research Association Newsletter (February 1983): 1-2; (August 1983): 1-3, 6-7.

Carnine, Douglas. "Mainstreaming Computers." Educational Leadership 41 (May 1984): 77-82.

Carter, Todd W. "City Schools Ahead of State Reform." The State News (Michigan State University), January 21, 1985, p. 12.

Checkpoint. Joint Newsletter of the Michigan Association of Computer Users in Learning and the Michigan Association of Educational Data Systems, January 1984, p. 2.

Chion-Kenney, Linda. "The 'Hidden' Cost of Computers." Education Week, February 27, 1985, p. 1.

________. "State Officials Report Their Intention to Expand Role in Computer Policy." Education Week, October 24, 1984, p. 10.

________. "Third of Students Have Access to Computers. Schools Entering 2nd Phase of Computer History, New National Survey Reports." Education Week, August 28, 1985, p. 5.

Christie, Bette J., and Dolan, Don. "Montana's Task Force on Computer Education." T.H.E. Journal 11 (November 1982): 92.

The Computing Teacher. Journal of the International Council for Computers in Education. (Theme issue: Computer Equity) 11 (April 1984).

Cory, Sheila. "A 4-Stage Model of Development for Full Implementation of Computers for Instruction in a School System." The Computing Teacher 11 (November 1983): 1-4.

Council of Chief State School Officers Resource Center on Sex Equity. "A Concern About Computer Equity." Concerns 12 (June 1984): 1-4.

Cuban, Larry. "Transforming the Frog Into a Prince: Effective Schools Research Policy and Practice at the District Level." Harvard Educational Review 52 (May 1984): 129-51.

Cupertino, California, Union School District. "K-8 Computer Literacy Curriculum." The Computing Teacher 10 (March 1983): 7-10.

Deal, Terrence E. "The Symbolism of Effective Schools." The Elementary School Journal 85 (May 1985).

Dede, Christopher. "The Likely Evolution of Computer Use in Schools." Educational Leadership 41 (September 1983): 22-24.

Dickson, W. Patrick. "Thought-Provoking Software: Juxtaposing Symbol Systems." Educational Researcher 14 (May 1985): 30-37.

Dollar, Bruce. "What Is Really Going on in Schools?" Social Policy 14 (Fall 1983): 7-19.

Downie, R. "Re-entry Experiences and Identity Formation of Third Culture Experienced Dependent American Youth: An Exploratory Study." Ph.D. dissertation, Michigan State University, 1976.

Dwyer, T. "Humanistic Strategies for Using Computers in Education." International Journal of Man-Machine Studies (1974): 6.

________. "Some Thoughts on Computers and Greatness in Teaching." In The Computer in the School: Tutor, Tool, Tutee, p. 87. Edited by R. Taylor. New York: Teachers College Press, 1980.

Edmonds, Ronald W. A Discussion of the Literature and Issues Related to Effective Schooling. St. Louis, MO: CEMREL, 1983.

________. "Effective Schools for the Urban Poor." Educational Leadership (October 1979): 15-23.

________. "Programs of School Improvement: An Overview." Educational Leadership 40 (December 1982): 4-11.

Education Daily. "States Pressured to Set Computer Literacy Standards. January 19, 1984.

Education USA. "Computer Use: The Beginning of a Revolution--Those Left Behind." 43 (January 1982).

Education Week. "Computer Literacy: A Survey of Initiatives for Teachers and Students Across the States." October 24, 1984, p. 11.

Eichner, Charlie. "Computer Network Will Link West Virginia Schools by 1986." Education Week, March 14, 1984, p. 14.

Ely, Margot. An Evaluation of the PAL/Consortium Computer Center Summer Computer Camp Equity Project. Technical Report No. 2. New York: Study of Interactive Technologies in Education, New York University, November 1984.

ETS Developments. "Major Impact Expected in Classroom." Princeton, NJ: Educational Testing Service, Spring 1984.

Evans, Christopher. Micromillenium. New York: Washington Square Press, 1979.

Ferrell, Barbara G. "Computer Immersion Project: Evaluating the Impact of Computers on Learning." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Ferres, Graham W. "Training and Implementation Strategies Appropriate to the Introduction of Logo into Teacher's Curriculum and Instruction." Ph.D. dissertation, University of Oregon, 1983.

Filliman, Paula K. "Guidelines for Introducing Microcomputers in the Schools." Arithmetic Teacher 30 (February 1983): 16-17.

Fire Dog, Pete. "Exciting Effects of Logo in an Urban Public School System." Educational Leadership 43 (September 1985): 1.

Foster, T. E. The Effect of Computer Programming Experiences on Student Problem Solving Techniques in Eighth Grade Mathematics. Madison: University of Wisconsin, 1973.

Fullan, Michael. The Meaning of Educational Change. Toronto: The Ontario Institute for Studies in Education Press, 1982.

Giroux, Henry A. "Public Philosophy and the Crisis in Education." Harvard Educational Review 54 (May 1984): 186-94.

Goldberg, Stan. "Computer Technology: Greatest Impact on America Since the Industrial Revolution." Creative Computing 10 (November 1984): 280-84.

Good, Carter Victor. The Methodology of Educational Research. Edited by A. S. Varr and D. E. Scates. New York: Appleton-Century-Crofts, 1954.

Goodlad, John I. A Place Called School: Prospects for the Future. New York: McGraw-Hill, 1983.

Gourgey, Annell F. "Coordination of Instruction as Reinforcement Enhancers of the Effectiveness of Computer Assisted Instruction." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Grant, Michael. "The Anatomy of Change." Thrust 13 (May-June 1983): 15-17.

Gray, Peter J. "The Use of Policy Analysis in Setting District Policy on Microcomputers." Educational Leadership 42 (October 1984): 72.

Grayson, Lawrence P. "New Technologies." In Instructional Leadership Handbook, p. 27. Edited by James W. Keefe and John M. Jenkins. Reston, VA: National Association of Secondary School Principals, 1984.

Greenberg, Selma. "The Pre-Kindergarten Child in a Post-Industrial World." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Greenes, C. "The Computer in Mathematics Education." Mathematics Teacher 74(8) (1981): 88-89.

Griswold, Philip A. "Elementary Students' Attitudes During Two Years of Computer Assisted Instruction." American Educational Research Journal 21 (Winter 1984): 737-54.

Guertin, Jeanne. "Strategies for Change: Dealing With the Information Society." Thrust 13 (May-June 1983): 30-31.

Hall, Gene E. "Issues Related to the Implementation of Computers in Classrooms." Journal of Computers in Mathematics and Science Teaching 1 (Winter 1981): 14-19.

________; Loucks, Susan F.; Rutherford, William L.; and Newlove, Beulah W. "Levels of Innovation: A Framework for Analyzing Innovation Adoption." Journal of Teacher Education 26 (Spring 1975): 52-56.

Hall, Keith A., and Tisone, J. M. "Computer-Based Education." In Instructional Leadership Handbook, p. 25. Edited by James W. Keefe and John M. Jenkins. Reston, VA: National Association of Secondary School Principals, 1984.

Hayes, Robert. "The Child, the Computer and Literature." Top of the News 23 (April 1967): 257-64.

Hechinger, Fred M. Education Agenda for the 1980's. Bloomington, IN: Phi Delta Kappa, 1981.

Hofmeister, Alan M. Microcomputer Applications in the Classroom. New York: Holt, Rinehart and Winston, 1984.

________. "The Special Educator in the Information Age." Peabody Journal of Education 62 (Fall 1984): 5-21.

Hollifield, John H. "In Reality, High Tech Means Low Skills, Poor Pay." R & D Report (1984): 3.

Howe, Harold. "Education Moves to Center Stage: An Overview of Recent Studies." Phi Delta Kappan 65 (November 1983): 167-72.

________. "Giving Equity in the Excellence Game." Paper presented to the Education Writers of America: The 1984 Martin Buskin Memorial Lecture National Seminar, Philadelphia, April 1984. (b)

________. "Symposium of the Year of the Reports: Responses From the Educational Community." Harvard Educational Review 54 (February 1984): 1-5.

Humphries, James T. Designing and Utilizing Mail Questionnaires in Educational Research. Carbondale: Publication and Research Office for Vocational Educational Studies, Southern Illinois University, May 1983.

Hunt, James B. "Action for Excellence." Educational Leadership 41 (September 1983): 14-18.

Hunter, Beverly; Dearborn, Donald; and Snyder, Bruce. "Computer Literacy in the K-8 Curriculum." Phi Delta Kappan 65 (October 1983): 115-18.

International Reading Association Computer Technology and Reading Committee. "Guidelines for Educators on Using Computers in Schools." Reading Research Quarterly 20 (n.d.): 120-23.

Johnson, Robert. An Educator's Guide to Microcomputers. Pontiac, MI: Oakland Schools, 1983.

Jorde, Paula, and Ford, Martin. "Microcomputers in Early Childhood Education." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Judd, Dorothy H. "The Status of Microcomputer Curricular Use in Selected Illinois Schools." Ph.D. dissertation, Northern Illinois University, 1982.

Juliussen, Egil. "Personal Computers in the 1990s." Creative Computing 11(19) (1984): 258-67.

Justiz, Manuel J., and Mason, Wart S. "A Changing NIE: Facilitating New Partnerships." Phi Delta Kappan 66 (December 1984): 277-80.

Klein, Elisa L. "Computer Graphics, Visual Imagery, and Spatial Thought." In Children and Computers: New Directions for Child Development, no. 28. Edited by E. Klein. San Francisco: Jossey-Bass, June 1985.

Klein, Karen, and Strother, Deborah. "Executive Summary." Planning for Microcomputers in the Curriculum. Bloomington, IN: Phi Delta Kappa, 1984.

Koerner, Thomas F. "Explosive Changes in Technology Create Skills Gap." NASSP Bulletin 66 (September 1982): 158.

Koetke, Walter. "Computers, Children and Learning: One Complete Iteration." Creative Computing 10 (November 1984): 163-69.

Komoski, Ken. "Educational Computing: The Burden of Insuring Quality." Phi Delta Kappan 66 (December 1984): 244-48.

________. "Guest Editorial." The Computing Teacher 11 (April 1984): 5-6.

Kreidler, William J. "Teaching Computer Ethics." Early Learning Journal (1984): 54-57.

Kulick, James; Bangert, Robert L.; and Williams, George W. "Effects of Computer-Based Teaching on Secondary School Students." Journal of Educational Psychology 75 (February 1983): 19-26.

Kulik, James A. "Synthesis of Research on Computer-Based Instruction." Educational Leadership 41 (September 1983): 19-21.

Lautenberg, Senator Frank R. "Equity in Computer Education." The Computing Teacher 11 (April 1984): 13-14.

Lee, Helen. "Training Teachers to Use Microcomputers." Paper presented at the annual meeting of the ADCIS Convention, Parma, OH, December 10, 1983.

Leonard, George. "The Great School Reform Hoax: What's Really Needed to Improve Public Education." Esquire (April 1984): 47-56.

Lesgold, Alan M. "Critical Research on Issues in the Implementation of Educational Technology." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Lewis, Arthur J. "Education for the 21st Century." Educational Leadership 41 (September 1983).

________. "Teachers, Pupils and Microcomputers." I.H.E. Journal 10 (February 1983): 87.

Lezotte, Lawrence W. "Equality of Educational Programs Within a School District. Three Criteria of Equity--Access, Participation and Outcomes Applied." Paper presented at the annual meeting of the American Educational Research Association, New Orleans, April 1984.

________. School Mission and Goals. An occasional paper. East Lansing: Department of Educational Administration, Michigan State University, 1985.

________, and Bancroft, Beverly A. "Growing Use of the Effective School Model for School Improvement." Educational Leadership 42 (March 1985): 23-30.

Light, Richard J., and Pillemer, David B. Summing Up: The Science of Reviewing Research. Cambridge, MA: Harvard University Press, 1984.

Lindelow, John. Administrator's Guide to Computers in the Classroom. Eugene, OR: ERIC/CEM Publications, 1983.

________. Microcomputers in the School Office: Primer for Administrators. Eugene: University of Oregon, ERIC Clearinghouse on Educational Management, 1984.

Linn, Marcia. "The Cognitive Consequences of Programming Instruction in the Classrooms." Educational Researcher 14 (May 1985): 14-29.

Lipsitz, Joan. "Educating the Early Adolescent: Why Four Models of Schools Are Effective in Researching a Difficult Age Group." American Education 17 (October 1981): 13-17.

Lockheed, Marlaine E.; Hunter, Beverly; Anderson, Ronald E.; Beazley, Richard; and Etsy, Edward T. Computer Literacy: Definitions and Survey Items for Assessment in Schools. Washington, DC: National Center for Educational Statistics, Government Printing Office, 1983.

Luehrmann, A. "Computer Literacy--What Should It Be?" Mathematics Teacher 7 (December 1981): 682-86.

M-STAR: Designs for Effective Instruction Conference. Lansing: Michigan Department of Education, February 11-12, 1985.

McCombs, Barbara. "Instructor and Group Process Roles in Computer-Based Training." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Market Data Retrieval. Microcomputers in Schools, 1983-84: A Comprehensive Survey and Analysis. Westport, CT: Market Data Retrieval, March 1984.

Mars, John D. "New Survey Shows Wide Use of Computers in Nation's Schools." Michigan School Board Journal 29 (April 1983): 30.

Marshall, Catherine, and Lynch, Kathleen K. "Analysis of Qualitative Data With Microcomputers." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Marshall, John C., and Bannon, Susan H. "Computer Attitudes and Knowledge in Rural Settings." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Melmed, Arthur S. "Information Technology for U.S. Schools." Phi Delta Kappan 63 (January 1982): 308-10.

Meyer, John W. "Innovation and Knowledge Use Within American Public Education." In Organizational Environment: Ritual and Rationality, pp. 233-60. Beverly Hills, CA: Sage Foundation, 1983.

Meyers, J. "A Letter From the Publisher." Time, January 3, 1983, p. 3.

Michigan Association for Computer Users in Learning. The MACUL Newsletter, May 1985.

Michigan Department of Education. "Applications for Discretionary and Special Project Grants." Lansing: State Department of Education, Office of Grants Coordination and Procurement, 1984-85. (Letter)

________. Better Education for Michigan Citizens: A Blue Print for Action. Lansing: Michigan State Board of Education, January 1984.

________. Listing of Michigan School Districts Classified by Major Community Type. Cited in "Memorandum from June Olson," May 10, 1978. Lansing: State Department of Education, 1971.

Michigan State Board of Education. Michigan K-12 Public School Districts Ranked by Selected Financial Data. Bulletin 1014. Lansing: MSBE, 1983.

Michigan, University of. Report on Project TMT. Ann Arbor: School of Education, University of Michigan, March 11, 1985.

Microsift. Portland, OR: Northwest Regional Educational Laboratory, Computer Technology Program, 1980.

Miles, Matthew B. "Unraveling the Mystery of Institutionalization." Educational Leadership 41 (November 1983): 14-18.

Miller, Benjamin S. "Bringing the Microcomputer Into the Junior High: A Success Story From Florida." Phi Delta Kappan 63 (January 1982): 320.

Minnesota Association for Supervision and Curriculum Development, Minnesota Association of School Administrators. The Use of a Computer to Help Teachers Teach the School Curriculum. Minneapolis: Minnesota Department of Education, 1982.

Minnesota Educational Computing Corporation. MECC Educational Computing Catalog 1984-85 School Year. St. Paul: MECC, 1984.

Molitor, G. The Futurist, April 1982, pp. 23-30.

Montana Office of Public Instruction. "How to Start a Computer Education Program." The Elements of Computer Education. Helena: Montana Office of Public Instruction, 1984.

Moore, Gwendolyn B., and Yin, Robert K. "Identifying Advanced Technologies for Education's Future." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Moursund, Dave. "Back to Basics." The Computing Teacher 21 (August/September 1984): 4-5. (e)

________. "Equity." The Computing Teacher 11 (April 1984): 3. (d)

________. "More Harm Than Good." The Computing Teacher 12 (1984-85): 3-4.

________. "38 Billion Curriculum Units: Thoughts on Fully Integrated and Individualized Instruction." Computing Teacher 12 (February 1984): 3-5. (b)

________. "To Improve Education." Creative Computing 11 (November 1984): 180-86. (a)

________. "The Two Percent Solution." Computing Teacher 2 (November 1984): 3-5. (c)

Naiman, Adeline. "Teacher Education: Microcomputers in Education: An Introduction." In Microcomputers in Education, pp. 21-24. Bloomington, IN: Phi Delta Kappa, 1984.

Naisbitt, John. Megatrends. New York: Warner Books, 1982.

Nasman, L. O. "Computers Mean New Decisions." Vocational Education 57 (April 1982): 36-38.

National Association of Elementary School Principals. Standards for Quality Elementary Schools: Kindergarten-8th Grade. Reston, VA: NAESP, July 1984.

National Commission on Excellence in Education. A Nation at Risk. Washington, DC: Government Printing Office, 1983.

National Committee for Economic Development. Investing in Our Children. New York: NCED, 1985.

National Council of Supervisors of Mathematics. "Statement of Basic Skills in Mathematics." Mathematics Teacher 71 (February 1978): 147-52.

National Council of Teachers of Mathematics. An Agenda for Action: Recommendations for School Mathematics for the 1980's. Reston, VA: NCTM, 1980.

________. "The Impact of Computing Technology on School Mathematics." Report of the NCTM Conference. Reston, VA: NCTM, 1985.

Natkin, Gerald. Planning for Microcomputers in the Curriculum: An Interview. Bloomington, IN: Phi Delta Kappa Center on Evaluation, Development, Research (CEDR), February 24, 1984.

Neuman, Delia. "Learning Disabilities and Microcomputer Coursework: A Qualitative Study of Students' and Teachers' Interactions With Instructional Dimensions." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Nytes, Gary L., and Musgades, Paul. "Sharing Technology: Keeping Rural Schools Alive." NASSP Bulletin 69 (November 1985): 33-35.

Oakes, Jeannie, and Schneider, Mark. "Computers and Schools: Another Case of the More They Stay the Same?" Educational Leadership 42 (November 1984): 13-19.

Olson, David R. "Computers as Tools of the Intellect." Educational Researcher 14 (May 1985): 5-7.

Papert, Seymour. Mindstorms: Children, Computers and Powerful Ideas. New York: Basic Books, 1980.

Parent, M. Joan. "Computers Alone Are Not Enough, House Panel Told." Education Daily, September 30, 1983, p. 3.

Passow, A. Harry. "Tackling the Reform Reports of the 1980's." Phi Delta Kappan 65 (June 1984): 674-83.

Patterson, Janice. Letter. Madison: Wisconsin Center for Educational Research, University of Wisconsin, August 9, 1984.

________, and Smith, Marshall. "The Role of Computers in Higher Order Thinking." Paper prepared for inclusion in the 1985 Yearbook for the National Society for the Study of Education, September 1985.

Patterson, W. P. "Battle of the Computer Heavy Weights." Industry Week 252 (1982): 33-40.

Pea, Roy D. "Prototype Pleas(e): Problem Solving Research for Educational Technologies." Paper presented to the annual meeting of the American Educational Research Association, Chicago, April 1985.

Perkins, D. N. "The Fingertip Effect: How Information-Processing Technology Shapes Thinking." Educational Researcher 14 (August/September, 1984): 1-8+.

Peterson, Karen Dusenbury. "The Effect of Individual Inservice Training on Teacher Use of an Innovative Technology: The Microcomputer." Ph.D. dissertation, Kansas State University, 1984.

Pogrow, S. "On Technological Relevance and the Survival of U.S. Public Schools." Phi Delta Kappan 63 (January 1982): 610-11.

Powell, J. C. Using Computers as Exploration Tools for Learners in the Classroom. Windsor, Ontario: University of Windsor, February 1984.

Principals' Planning Guide for Microcomputers. Lansing: Michigan Department of Education and the Michigan Council of Teachers of Mathematics. [Printed by Birmingham, Michigan, Public Schools]

Puttkamer, Jesco von. "The Future: Do We Have a Choice?" Educational Leadership 41 (September 1983): 4-5.

Ragan, A. "Florida: A Mandate for Educational Computing." Electronic Learning 2 (February 1983): 32-33.

Rawitch, Don G. "MECC: A Guiding Light for Statewide Instructional Computing." NASSP Bulletin 6 (September 1982): 78-82.

Raymont, Patrick G. "Some Policy Issues in Computing Education in England and Europe." T.H.E. Journal 10 (January 1983): 95.

Reisler, Raymond F. "The Impact of Technology on Work: How Our Society Should Prepare Our Future Work Force." IEL Network News (Fall 1984): 5.

Rockman, S.; White, D. J.; and Rampy, L. "Computers in the Schools: The Need for Policy and Action." Educational Technology 23 (November 1983): 13-18.

Roth, Gene L., and Fesolowski, Dennis A. "Microcomputer Competencies for Vocational Teachers." The Computing Teacher 12 (November 1984): 64.

Rubin, A., and Bruce, B. Quill: Reading and Writing With a Microcomputer. Report no. 5410. Cambridge, MA: Bolt, Beranek, and Newman, Center for Study of Reading, September 1983.

Rutkowski, Chris. "The Computer as a Creative Tool." Creative Computing 11 (November 1984): 97-98.

Salas, Gumecindo. "New Educational Technologies: Burdens and Rewards." Michigan School Board Journal 29 (April 1983): 8-9.

Sang, Herb A. "Academic Excellence Is a 24-Hour Challenge." Creative Computing 10 (December 1984): 113-18.

Sattel, Sue. "Microcomputer Uses in the 1980's." Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada, April 1983.

Sax, Gilbert. Foundations of Educational Research. Englewood Cliffs, NJ: Prentice-Hall, 1979.

Schauble, Leona. "Computer Contexts for Learning and Development." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

"School Effectiveness, Technology Top 1986 NIE Research Agenda." Report on Education Research, February 13, 1984, pp. 1-2.

SchoolTech News (Educational News Service), March 1984, p. 2.

Shane, Harold G. "The Silicon Age and Education." Phi Delta Kappan 63 (January 1982): 303-308.

________. "The Silicon Age II: Living and Learning in the Information Epoch." Phi Delta Kappan 65 (October 1983): 120-26. (a)

________. "On Education and the Future: A Conversation With Harold Shane." Educational Leadership 41 (September 1983): 11-13. (b)

________, and Tabler, Bernadine. On Education for a New Millenium. Bloomington, IN: Phi Delta Kappa, 1981.

Shavelson, Richard J., and Salomon, Gavriel. "Information Technology: Tool and Teacher of the Mind." Educational Researcher 14 (May 1985): 1.

Shavelson, Richard J.; Winkler, John D.; Stasz, Cathleen; Feibel, Werner; Robyn, Abby E.; and Shaha, Steven. Successful Teachers' Patterns of Microcomputer-Based Mathematics and Science Instruction. Santa Monica, CA: The Rand Corporation for the National Institute of Education, March 1984.

Sheingold, Karen; Kane, Janet H.; and Endreweit, Marie E. "Microcomputer Use in Schools: Developing a Research Agenda." Harvard Educational Review 53 (November 1983): 412-31.

Shoen, H., and Hunt, T. "The Effect of Technology on Instruction: The Literature of the Last 20 Years." AEDS Journal 10 (1977): 68-82.

Shotwell, Steven. *Quality Inservice: A Key to Establishing and Maintaining a Computer Education Program*. Troy, MI: Troy Public Schools, 1983.

Simon, Herbert A. *Computers in Education: Realizing the Potential*. Department of Education Conference on Computers in Education. Pittsburgh: University of Pittsburgh, November 1982.

Sinclair, Clive. "Predictions on Our Computerized Future." *Creative Computing* 11 (November 1984): 254-58.

Sizer, Theodore R. *Horace's Compromise: The Dilemma of the American High School*. Boston: Houghton-Mifflin, 1984.

Slavin, Robert E. *Research Methods in Education: A Practical Guide*. Englewood Cliffs, NJ: Prentice-Hall, 1984.

South Dakota Department of Public Instruction. *Computers in South Dakota Schools*. Pierre: Division of Elementary and Secondary Education and Instructional Services, May 1984.

Stasz, Cathleen, and Winkler, John. "District and School Incentives for Teachers' Instructional Uses of Microcomputers." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Stewart, L. R. "Here's What Computers Can Do." *American School Board Journal* 169 (March 1982): 33.

Streibel, Michael J. "A Critical Analysis of Computer-Based Approaches to Education: Drill-and-Practice, Tutorials, and Programming/Simulations." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Stronge, James H. "Funding Computer Related Technology in the Public Schools." *The Computer Teacher* 11 (August 1983): 13-15.

Tashner, John. *Computer Literacy for Teachers: Issues, Questions and Concerns*. Phoenix, AZ: Oryx Press, 1984.

Tobin, Catherine D. "Developing Computer Literacy." *Arithmetic Teacher* 6 (February 1983): 251-54.

Turkle, S. *The Second Self: Computers and the Human Spirit*. New York: Simon and Schuster, 1984.

Wagschal, Peter H. "A Last Chance for Computers in Schools." *Phi Delta Kappan* 6 (December 1984): 251-54.

Walker, Decker F. "Reflections on the Educational Potential and Limitations of Microcomputers." Phi Delta Kappan 65 (October 1983): 103-107.

Walker, Elaine, and Azumi, Jann. "The Impact of Computer Assisted Instruction on Mathematics Learning: Gains of Elementary Schools." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Wallace, James W. "Write First, Then Read." Educational Leadership 42 (February 1985): 20-21.

Watt, Molly. "What Is Logo?" Creative Computing, October 1982, p. 120.

Webb, Noreen M. "Microcomputer Learning in Small Groups: Cognitive Requirements and Group Processes." Journal of Educational Psychology 76 (1984): 1040-88.

Weir, Sylvia. "Logo as an Empirical Window, an Excerpt From the Draft of the Forthcoming Book, Untrapping Intelligence." Panelists' Papers, 1984.

Weir, Sylvia; Russell, Susan J.; and Valanta, Jose A. "Logo: An Approach to Educating Disabled Children: Action Oriented Learning Has Dramatic Benefits." Byte (September 1982): 346-58.

White, Mary Alice. "The Electronic Learning Revolution: Questions We Should Be Asking." Prospects (UNESCO) 14(1) (1984): 23.

________. "The Schools and the Future of Electronic Learning." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

________. "Synthesis of Research on Electronic Learning." Educational Leadership 40 (May 1983): 13-14.

Wilson, Kara Gae. "Administrative Guidelines for Introducing Computers Within the Curriculum." NASSP Bulletin 66 (September 1982): 6-11.

Wilson, Thomas R. "MICROMAC at Rosemount High School." Phi Delta Kappan 66 (December 1984): 255-56.

Wimmer, Ron. "A Study of Teacher Concerns About the Adoption of the Microcomputer as an Educational Innovation." Ph.D. dissertation, University of Kansas, 1984.

Winkle, Linda W., and Malhuis, Walter M. "Computer Equity Comes of Age." Phi Delta Kappan 63 (January 1982): 314-14.

Winkler, John D., and Stasz, Cathleen. "A Survey of Incentives for Staff Development of Computer-Based Instruction." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985.

Wisconsin Center for Educational Research. On Wisconsin Computing Newsletter (University of Wisconsin), December 1984.

Workman, B. "Teaching Writing." In Computers in Education: Realizing the Potential. Report of a Research Conference. Washington, DC: Department of Education, Office of Educational Research and Improvement, November 1982.

Wright, Douglas A.; Melmed, Arthur; and Farris, Elizabeth. Instructional Use of Computers in Public Schools. National Center for Education Statistics, Fast Response Survey System, Report no. 14. Washington, DC: Government Printing Office, 1982.

Zimiles, Herbert. "The Changing American Child." Paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1985. In press in T. M. Tomlinson and H. Walberg (eds.), Students and Societyy: Life and Work in Public Schools. NSSE Yearbook. Chicago: University of Chicago Press, 1985.

Zolton, Ronald. Proposal for Statewide Effective Computer Applications Network. Saginaw, MI: Saginaw Intermediate School District, January 1983.

Zucker, Andrew A. "Computers in the School: A Case Study." Phi Delta Kappan 63 (January 1982): 317-19.