Improving Instruction with Microcomputers:

Readings and Resources for Elementary and Secondary Schools

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Edited by John H. Tashner

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The rare Arabian Oryx is believed to have inspired the myth of the unicorn. This desert antelope became virtually extinct in the early 1960s. At that time several groups of international conservationists arranged to have 9 animals sent to the Phoenix Zoo to be the nucleus of a captive breeding herd. Today the Oryx population is over 400 and herds have been returned to reserves in Israel, Jordan, and Oman.

*This book is dedicated to teachers and learners
everywhere who are investigating, experimenting, and
trying to understand the role that computers may have
in our schools and in the education of our children.*

Foreword

Increasing numbers of educators are attempting to solve instructional problems through the use of microcomputers. A few educators are proclaiming the multitude of advantages available to microcomputer users. But many are still wondering what the "computer revolution" is all about, and some still have vague fears that computers threaten their job security.

In this book, John Tashner has collected the best of current writings on microcomputers: writings that show microcomputers' impact on education and their uses in it. The articles selected not only pave the way for readers by tracing the past and predicting the future of microcomputers in the classroom, they also provide the facts upon which to base decisions about getting started in using computers and in selecting equipment.

The reader will also find descriptions of various computer languages and discussions of their uses in educational applications. The book relates the problems surrounding software production and projects some possible solutions.

Selected articles deal with the uses of the micro in school administration and in teaching specific subjects, including managing the school library. Also covered are the management of school records and programs, the management of instruction, the business management of the school or school district, and the management of special education programs. Finally, a complete chapter is devoted to preparing teachers and school districts to make use of the new computer technology.

The book concludes with a glossary of computer education terms and a list of information sources. Both should be valuable to readers who will also find suggested additional readings listed at the end of each of the seven chapters.

At this time there are more than 10 journals devoted entirely to microcomputers in education and many more in which an occasional article on the topic appears. Few educators can afford the money to subscribe to all of these, and no one has the time to read them all. Consequently, the compiler and editor of this collection has done his readers a great service. Here, in one book, are representative articles culled from months of searching and evaluating.

Read it gratefully.

George E. Mason
Department of Reading Education
University of Georgia
Athens, Georgia

Preface

The recent developments in microcomputer technology have stimulated much interest and excitement among professional educators, business leaders, government officials, and the general public who are concerned about improving the quality of schooling and adequately preparing the present generation of students to enter the work world. Many books and journals have appeared in the last several years with information about the role of microcomputers in instruction. At the same time students are now entering school with strange vocabularies and skills learned in self-taught home computing activities. Some say that we are experiencing a *computer revolution* which may have as much impact upon society as the printing press did 500 years ago. Parents, teachers, and administrators are attempting to sort through the available information to determine how best to use this newly acquired technology.

Several questions continue to surface in discussions with educators about the use of computers in schools.

1. What is the computer revolution really about?

2. Just what is a microcomputer and what kinds are available?

3. How can microcomputers be used in a classroom with pupils?

4. How much and what kinds of training are needed to enable teachers to use them effectively?

This book was developed to explore each of these questions by presenting the state-of-the-art perspectives of recognized and experienced experts in the field. The primary focus is to assist the professional education community and concerned public to gain a more clear understanding of the background causes, the current uses, and the potential of instructional microcomputer capabilities in elementary and secondary schools.

The articles chosen for each chapter represent the end product of a comprehensive search of literature dealing with the use of computer technology in educational settings. Many were found in the DIALOG computer database and the MICROCOMPUTER INDEX file. Other essays were selected from personal reading and investigations of the educational microcomputing field. In addition, many were recommended for inclusion by teachers and administrators during inservice programs conducted by the author.

Several criteria were used to determine which articles should be included. First, each article was to make a unique contribution to the topic in question. Many articles written for educators about microcomputers tend to be rather general and consist of urging teachers to learn about and include this high technology in the classroom. Second, the technical language in each article was to be clearly defined in such a way that interested laypersons would find the information understandable and useful. (To further help the reader understand specific terms, a glossary has been compiled and located at the end of this book.) Third, in general, short one-page articles were discarded in favor of those presenting more depth and information. Fourth, with very few exceptions, articles chosen were those that had been published since 1982. Every effort was made to ensure that the most recent information is presented and discussed. Last, but certainly not least, articles must have been written in a clear, straightforward, and interesting style in order to assist the reader rather than test his or her endurance.

In order to provide continuity the articles have been grouped into seven sections. Section I presents an overview of the computer revolution, communications technology, and the implications of these for education. Sections II and III introduce microcomputer systems and languages now in use in schools. Sections IV through VI investigate educational software and how it is being used for classroom instruction and management. Section VII describes the task of preparing educators to meet the challenge of using this new technology and presents examples of how this might be ac-

complished. An annotated bibliography (''Recommended Reading'') is included at the end of each chapter to assist the reader in further in-depth study. Appendices include lists of journals focusing on educational applications of microcomputers as well as other resources to assist in program development. A glossary of terms relating to microcomputer technology concludes the book.

John H. Tashner
Associate Professor
Department of Secondary Education
Appalachian State University
Boone, North Carolina

Acknowledgments

The synthesis of ideas into any book requires assistance and help from many people. This one is no exception, and I want to thank my colleagues and students who have given so much of their time, effort, and encouragement in order to see this project finished. I would especially like to thank Bob Nicklin for arousing my interest in the educational potential of microcomputers several years ago and for working with me in providing training programs for educators in our region. The actual document was the result of a request and challenge from James Thomas. Ali Emdad made many useful suggestions throughout the preparation of the manuscript. Karen Hester and Maxine Disbrow, with additional help from Margaret Clegg, provided many of the organizational details and typing. I also want to thank the many authors and publishers for granting permission to reprint their respective articles. Finally, I want to express my appreciation to my family for their patience and endurance throughout.

Introduction

"Human history becomes more and more a race between education and catastrophe"

—H. G. Wells

A new breeze is blowing across the educational landscape. It whispers of promises built upon new technologies, of students and teachers speaking in strange languages, and of never-before-met goals of teaching and learning. Without question, the hottest topic among educators today is the role of microcomputers in schools.

This interest has undoubtedly come from two major sources. First, the news media have been inundating us with reports concerning the transition of our society from an industrial base to an information processing base—and they cite some impressive facts. For instance, only about 17 percent of our work force was engaged in information jobs in 1950. Today, about 60 percent of us manipulate information as a major part of our employment. Along with this increase in information processing is the dramatic increase in the automation of the work force.

The second major source of interest in computers in schools comes from the recent developments in computers themselves. Compared with just a few years ago, computers that are relatively cheap, powerful, and able to perform functions useful to educators are now available. John Naisbitt, in his recent best-seller *Megatrends* (New York: Warner, 1983) suggests that adoption of this new technology will take place in our society in three stages: (1) applications of new processes to old industrial tasks; (2) their use in improving previous technologies; and, (3) discovery of new directions. He believes that we are now engaged in the second stage.

Experts are now appearing to tell us whatever we want to hear about the impact that these mechanistic marvels will have on our children's lives, their careers, and, of course, their education. Some offer caution and say such technology, in its present state, has little to offer teachers in helping youngsters acquire the foundation necessary to achieve in our society. These people point out that, while microcomputers are cheap by rela-

tive standards, they are still too expensive for schools that are strapped for dollars. They also point out that too few machines are available in schools and that the instructional materials now available are of questionable quality. Finally, some people wonder where to find the expertise among our schools' faculties, those who are required to appropriately use computer technology with students.

Most educators, though, discount these problems and are highly interested in the possibilities offered by using microcomputers in schools. Beginning to explore these applications in earnest, they point out that the educational process must prepare young people to meet
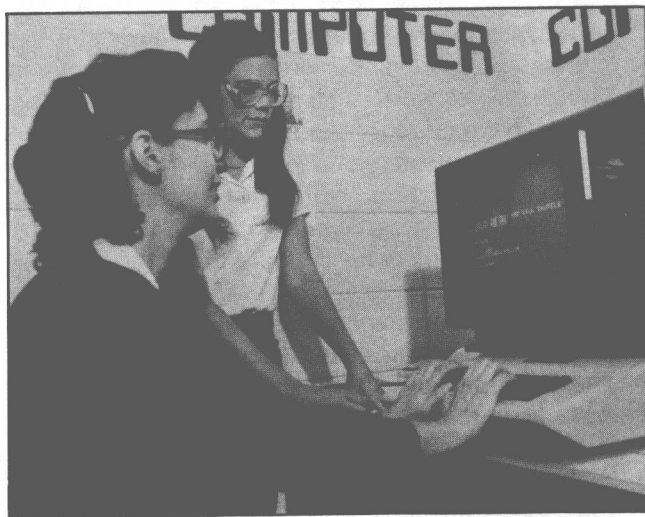
the needs and challenges of the newly evolving information society. These people suggest that computer literacy will become a must for entrance into many careers and jobs. Some even suggest that interaction with computers may actually change the way we mentally process information—in short, how we think.

Well, it sounds like old times, doesn't it? Remember instructional television—the answer to all our problems? Or how about videotape recorders—those machines with complicated wire hook-ups to the monitors and cameras designed to assist us in instruction (but

which may still be found in the back closet of that "temporary classroom" out behind the gym). Is this microcomputer hype just another fad with much smoke and little substance? Where does the truth and reality lie among the divergent views of this new technology? To be sure, most points of view are correct to a point, and final answers are, of course, not yet known.

What we do know is that about one million micro-computers were estimated to have been sold by 1980 and four million by the end of 1982, with sales projected to increase by 50 percent per year in the next several years. According to a frequently quoted report issued in 1981 by the National Center for Education Statistics, only one school in four had access to a computer in the beginning of the 1980–1981 school year. But in the explosion of interest about our changing society and the increasing availability of products and information, this figure is increasing exponentially. A grassroots movement is underway in many communities to obtain and implement classroom computer instruction. Schools are acquiring micros in many unusual ways—from PTAs and bake sales to outright solicitations for donations from the community. Following are some examples.

- Minnesota Educational Computer Consortium (MECC) was established in 1973 to develop a state-wide educational computing effort. Its leadership has enabled a reported 95 percent of K–12 pupils in Minnesota to work with computers. Many other states have reportedly taken similar leadership positions. These efforts include state and regional conferences, newsletters, workshops, consultation, and quantity purchase agreements.
- Fairfax County Public Schools, Fairfax, Virginia, has purchased a large number of microcomputers for use in their elementary and secondary schools. Many larger school systems have taken a similar course.
- The feasibility of using microcomputers to educate students in remote areas is being investigated in the Alaskan bush country.
- Wake County Public Schools, Raleigh, North Carolina, received $600,000 worth of donated equipment from IBM to investigate the possibilities of teaching elementary students to read and write by microcomputer.
- A gifted/talented class in one rural elementary school received three microcomputers for a computer literacy program by requesting donations from parents.
- The Lawrence Hall of Science, University of California, Berkeley, is a public museum that offers various courses about computers to the general public, school groups, and educators.
- The advertisement of any microcomputer course for educators results in an overflow crowd at most pro-fessional meetings, inservice programs, and universities across the country.

And a new ingredient, not present before, has been added into the educational innovation formula: For the first time we have students coming to school with experience from home computer use, from arcades, museums, and even public libraries—and *they are coming wanting to learn*. This demand for microcomputing instruction is being strongly felt in our schools, at all levels, and in most subjects. Indeed, many professional journals in education have recently devoted entire issues to the development and implementation of computer literacy programs and to the applications of computers to the instructional process. Some colleges are requiring that all entering students acquire microcomputers to assist them in their studies. Some high schools are even reportedly including computer literacy competencies as part of their graduation requirements.

Students are not standing on the sidelines waiting for us to make up our minds. Note the numbers of expensive ($2790 for 8 weeks) computer camps for youngsters that fill up far in advance of the deadline. Students have become involved in teaching themselves, each other, and in some cases, their own instructors, through sharing information in informal user groups, individual study, and other outside-of-school activities. In many cases, teachers and students are learning together in the classroom, each teaching the other new techniques, sharing information, and developing an expanding knowledge of possible applications for their needs and interests.

Attempts at computer-assisted instruction during the 1960s using the large mainframes connected to single terminals in distant locations provided many bad experiences and led educators to view computerized education with skepticism. Student access was severely limited by the prohibitive cost and few terminals. Limited time schedules, lack of adequate software, and frequent periods of time during which the computer was inoperable were cited as major obstacles.

The development of microcomputers in the late 1970s and early 1980s may change the picture. These computers are now self-contained units which take up the same space as a small desk-top typewriter and a small television set. In fact, many of the most popular models are made to operate with a home or school television as a screen display. Microcomputers have real advantages over their mainframe predecessors. They are small, cheap, and have expanded capabilities. Many are more powerful than their larger forerunners of just a few years ago. They can be used in any combination of text, sound, pictures, color graphics, animation, and even speech! And, while many applications are still

state-of-the-art, schools are now experimenting and using micros in some of the following ways:

1. *Studying about the computer itself*. This includes learning about what a computer is, how it works, what it can and cannot do, how it is currently being used in the work force, and its potential impact on society. Such programs are usually listed as *computer literacy* or *computer awareness* and often may include some programming skills.

2. *Using the computer to teach subject matter*. Effective computer-assisted instruction presents material at the student's level of ability and provides individualized attention to students as they progress through the curriculum. The interactive nature of these machines provides for self-paced instruction and encourages students to experiment and take risks as a part of the learning process without fear of judgment when mistakes are made. Computers also have tremendous patience and will work with a student on a given task as long as necessary or permitted. Tutorial and practice programs in elementary skill areas use computers in this manner.

    Microcomputers are being used in science classes as tools to collect and analyze data for student interpretation. Color, graphics, and animation characteristics are being used in art classes, and sound characteristics are being used by the music teachers to help students learn music theory and composition. Even in the lower elementary grades, a new language called Logo is being used for young children to explore, create, and learn to control the computer as well as for other instructional activities. Schools are also testing the feasibility of using computers to teach young children to read and write.

3. *Using the computer to teach decision-making skills*. Educators usually cite the ability to think and to make informal decisions as being the most important goals and objectives of education. Students are able to analyze problems, synthesize information, and learn to make decisions in a logical manner with computer assistance. Simulations of real life situations enable the manipulation of one of several variables at a time and provide immediate feedback on the results and implications of these decisions. Problem-solving skills may also be developed by learning to program the computer. By developing a number of step-by-step procedures, students learn to solve complex problems.

4. *Using the computer for the management of instruction*. Record keeping of all sorts is now possible with the use of microcomputers. In the office, personnel files, student files, attendance records, budget records, and inventory, among others, are being computerized with micros. In the classroom, records on the curricular progress of students can now be kept. The best computerized instructional programs have management and record-keeping functions built in as an integral part. Individualized education plans can now be developed for each pupil with more ease. Continuous progress plans can be implemented and monitored. Used as a word processor, the computer can be used for the preparation and printing of problems, assignments, and tests as well as for letters and other communications.

5. *Using the computer to obtain information not available in the library or media center*. Students and teachers have access through their microcomputers to many large databases throughout the country. This enables teachers to obtain annotated bibliographies on specific topics, to acquire the most recent information for students, and to keep track of such topics as the stock market. Computer users throughout the country can also be connected together to share information and solve mutual problems.

We see, then, that a microcomputer represents another tool that can be and is being used by educators to assist in the learning process. These machines will not replace teachers nor substantially alter schools in the next few years as some have claimed. But schools will be affected by these machines, and educators will have more opportunities to investigate, to experiment, and to learn to use them as microcomputers continue to find their way into classrooms.

What, then, do teachers need to know about microcomputers and where can they get appropriate training? It appears that different levels of knowledge will be needed, depending on what the instructor plans to do. A basic goal ought to be an understanding of the trends toward automation and information processing in our society and the implications for the future. In order to teach elementary computer literacy or awareness courses, teachers should also have some understanding

of how a computer works and how to operate it. Of course, if the introduction of computer programming is to be included, then a knowledge of programming is necessary, but many teachers may need only to know how to operate the machine and how to use prepackaged programs. Others may wish to develop some of their own programs and thus need programming knowledge.

The literature concerning computer use in schools seems to be moving away from descriptions of machines and how they work toward more examples of how teachers and students can actually use them in the school office and classroom. It is in this *integration* of classrooms and computers, *where the computer becomes a tool rather than a subject,* that students really will be learning skills that they can carry forth into the future.

A final thought has to do with judgment—how do we test for results? Evaluation in education has traditionally been focused upon whether "Method A" is better, faster, less expensive, or whatever than "Method B." Some sort of test is usually given to each student group before and after treatment, and average score gains are compared statistically in some way for overall results. Many of the innovative national curriculum projects developed by the National Science Foundation in the 1960s were compared to traditional courses in this manner. When tests that were based upon the goals and objectives of the traditional courses were used, the traditional courses were found to be superior. However, when tests were designed and administered based upon the innovative courses' concepts and skills, the traditional courses were found to be inferior. *It is very important that we understand and define what we want computers to do for us before we begin to evaluate them by comparisons with other methods and processes.*

As futurist Alvin Toffler, author of *Future Shock* and *The Third Wave* stated in a recent interview:

> I am under no illusion that it is easy for people who actually work with the system to make the kinds of changes I am talking about. . . . Nevertheless, it seems to me the agenda is clear. These fundamental changes must be made if our kids are going to survive the transition into this new society.*

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*"Technology and Education: Schools in the Third Wave," interview with Alvin Toffler, edited by Cindy Tursman, *The School Administrator* 38 (7) (April 1981): 30.

Contents

Section I
The Computer Revolution, Communications Technology, and Education

Introduction

The recent and fast-paced development in the field of telecommunications has already begun to change the way governments, industries, and businesses conduct their affairs. Experts suggest that we are quickly moving into a postindustrial society based upon information processing capabilities. The foundation of this new technology is the silicon chip and the microprocessor; these are the bases of the so-called "computer revolution." Educators are once again being called upon to prepare young people to meet the challenges implicit in this changing world. This time it is microcomputer technology and its applications. Does this sound all too familiar? Is it just another panic with which educators must cope? Is it the panacea for which we have long been waiting? Or is it just another tool that offers promise in the education of students?

Just what is this "computer revolution" really about and how does it relate to education, schooling and learning? In "The Silicon Age and Education," Harold G. Shane traces the growth of the information society and its possible impact on the school curriculum. The ultimate outcome may be the creation of a "new society" in which improved life-styles emerge from a blend of increased educational opportunities and advancing technology.

The development of pocket-sized teaching computers is discussed in Christopher Evans's "An Invitation to the (Near) Future." Current computer video and print output methods may give way to voice interactions in the 1990s.

A major area needing critical analysis is what constitutes "Computer Literacy"? Is it an understanding of the inner workings of the electrical apparatus? Does it include programming skills? If so, at what level and in which languages? Or does computer literacy suggest a knowledge of applications of computers in our society? "Squaring off over Computer Literacy" by Lee The'discusses the implications of computers used as tools in schools and suggests ways we can become increasingly computer knowledgeable. The' argues for *computing* instruction involving language handling to obtain information and make decisions as opposed to *computer* instruction, a process rather than a product approach.

David C. Johnson et al, in "Computer Literacy-What Is It?," substantiates this broad definition of computer literacy in advocating certain computer experiences for all pupils. These experiences are stated in the form of cognitive and affective objectives in the areas of hardware, programming, applications, impact and attitudes. Johnson et al's report, although dated, represents an attempt to develop and validate a list of specific objectives which might comprise a course concerned with computer literacy. These objectives created quite a controversy in 1980 which still rages today— what do youngsters need to know about computers?

It seems clear that the continuing development of information processing will affect all institutions within our society, including schools. The potential development of large systems of instructional technology based upon the microcomputer raises some serious and profound questions for educators. Sharon P. Robinson summarizes and puts these questions into focus for educators in "Questions for Teachers." The entire teaching profession needs to be involved in planning and shaping the future of education for the coming technological society. Educators must therefore reexamine the purposes, processes and problems of educating our youth.