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ABSTRACT

This compilation of four papers provides an overview of recent developments in communications technologies and suggests how these developments will affect adult, career, and vocational education. Following an introduction, by Juliet V. Miller, that both summarizes each of the papers and synthesizes the information presented, the first paper, by Christopher J. Dede, considers the reshaping of adult, career, and vocational education by the emerging communications technologies. Discussed are the way changes are affecting the world of work and, subsequently, educational content and delivery. The second paper, "Recent Developments in Telecommunications Technology," by Frank W. Norwood, reviews developments that will lead to the home becoming a telecommunications center with the capability of delivering a wide variety of knowledge and instruction. Next, Jo Ann Harris-Bowlsbey, in "Educational Applications of Communications Technology," addresses three questions: (1) How can educators be trained to use communications technologies? (2) How can computers assist individuals in career decision making? and (3) How can computers be used to support instruction? The final paper, by Katy Brown Greenwood, focuses on the need for and process of developing a philosophy to guide the use of communications technology in vocational education. The author emphasizes studying alternative futures and past and current values in order to broaden vocational education for the preferred future. A list of references concludes the document. (DTT)

COMMUNICATIONS TECHNOLOGIES: THEIR EFFECT ON ADULT, CAREER, AND VOCATIONAL EDUCATION

INFORMATION SERIES NO. 244

Norman M. Singer
Editor
The National Center for Research in Vocational Education

Juliet V. Miller
The National Center for Research in Vocational Education

Christopher J. Dede
University of Houston at Clear Lake

Frank W. Norwood
Joint Council on Educational Telecommunications

Jo Ann Harris-Bowlsbey
Towson State University

Katy Brown Greenwood
Texas A&M University

The ERIC Clearinghouse on Adult, Career, and Vocational Education
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio 43210

1982

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For further information contact:

The Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio 43210

Telephone: (614) 486-3655 or (800) 848-4815
Cable: CTVOCEDOSU/Columbus, Ohio
Telex: 8104821894

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FOREWORD

The Educational Resources Information Center Clearinghouse on Adult, Career, and Vocational Education (ERIC/ACVE) is one of sixteen clearinghouses in a nationwide system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered into the ERIC database. This paper should be of particular interest to adult education, career education, and vocational education practitioners and decision makers.

The profession is indebted to Norman M. Singer and Juliet V. Miller, the National Center for Research in Vocational Education; Christopher J. Dede, the University of Houston at Clear Lake; Frank W. Norwood, Joint Council on Educational Telecommunications; Jo Ann Harris-Bowlsbey, Towson State University; and Katy Brown Greenwood, Texas A&M University, for their scholarship in the preparation of this paper.

Dr. Singer is a Senior Research Specialist responsible for dissemination leadership and coordination at the National Center and among vocational education Research Coordinating Units, Curriculum Coordinating Centers, and other agencies nationwide. Since joining the National Center ten years ago, Dr. Singer has developed and directed various programs in career, adult, and vocational education.

Dr. Miller is a Senior Research Specialist at the National Center, where she serves as Director of the ERIC Clearinghouse on Adult, Career, and Vocational Education. She is President of the National Vocational Guidance Association and has written numerous articles, monographs, and books on the topics of career education, and guidance and counseling.

Dr. Dede, Professor of Education and Futures Research, University of Houston at Clear Lake, is a past president of the Education Section, World Future Society. He has published extensively in the areas of educational futures, instructional technology, science education, and educational policy and is currently consulting with the Office of Technology Assessment, U.S. Congress, on a major study of information technology in education.

Mr. Norwood serves as Executive Secretary of the Joint Council on Educational Telecommunications, Washington, D.C. Before joining JCET, he served as a Program Associate for higher education at the Agency for Instructional Television, where he held a joint appointment on the faculty of Indiana University's Department of Radio and Television.

Dr. Harris-Bowlsbey is Senior Counselor and Professor in Psychology at Towson State University, Baltimore, Maryland, as well as President of DISCOVER Foundation, Inc., a nonprofit educational organization specializing in the development of computer-based career development systems. Dr. Harris-Bowlsbey and her team are authors of Computerized Vocational Information System (CVIS), Discover I, Discover II, and Discover III. She has written many journal publications as well.

Dr. Greenwood is Assistant Professor in Vocational Education at Texas A&M University and Project Director of a vocational education technical assistance project for the Dominican Republic. Her major interests are in philosophy, policy issues and development, and history of education-for-work systems.

Recognition is also due to Steven G. Sachs, Northern Virginia Community College; to Mary Lindenstein Walshok, the University of California at San Diego; and to Robert Abram and William Ashley, the National Center for Research in Vocational Education, for their critical review of the manuscript prior to its final revision and publication. Lana Pipes, Association for Educational Communications and Technology, provided a suggested framework that guided the development of the publication; and Susan Imel, Assistant Director at the ERIC Clearinghouse on Adult, Career, and Vocational Education, coordinated the final editing and production of the publication. Production assistance was provided by Sandra Kerka, Catherine Thompson, and David Tipton. Brenda Hemming and Carmen Smith typed the manuscript, and Janet Ray and Marilyn Deal served as word processor operators. Editing was performed by Connie Faddis and Janet Kiplinger of the National Center's Editorial Services.

Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

This compilation of four papers provides an overview of recent developments in communications technologies and suggests how these developments will affect adult, career, and vocational education. Following an introduction that both summarizes each of the papers and synthesizes the information presented, the first paper, by Christopher J. Dede, considers the reshaping of adult, career, and vocational education by the emerging communications technologies. Discussed are the way changes are affecting the world of work and, subsequently, educational content and delivery. The second paper, "Recent Developments in Telecommunications Technology," by Frank W. Norwood, reviews developments that will lead to the home becoming a telecommunications center with the capability of delivering a wide variety of knowledge and instruction. Next, Jo Ann Harris-Bowlsbey, in "Educational Applications of Communications Technology," addresses three questions: (1) How can educators be trained to use communications technologies? (2) How can computers assist individuals in career decision making? and (3) How can computers be used to support instruction? The final paper, by Katy Brown Greenwood, focuses on the need for and process of developing a philosophy to guide the use of communications technology in vocational education. The author emphasizes studying alternative futures and past and current values in order to broaden vocational education for the preferred future. A list of references concludes the document.

Literature relating to the topic of communications technology as it applies to adult, career, and vocational education can be found in the ERIC system under the following descriptors: *Telecommunications; *Technological Advancement; Education Work Relationship; *Futures (of Society); *Educational Philosophy; *Computers; Computer Assisted Instruction; Computer Science; Educational Change; *Educational Technology; Social Change. Asterisks indicate descriptors having particular relevance.

QUESTIONS ABOUT COMMUNICATIONS TECHNOLOGIES FOR EDUCATORS: AN INTRODUCTION

Juliet V. Miller
The National Center for Research in Vocational Education

Developments in communications technology are advancing rapidly. Theobald (1979) indicates that the move from the industrial to the communications era is comparable to the historical move from the agrarian to the industrial era. This movement involves more than the development of new hardware and technology; it will result in a revolution in the way human beings function and the way they interact with and "know" the world.

Newcomb (1979) describes the influence of telecommunications on education this way: "Education and educators are about to be shoved into an era when many comfortable axioms of teaching and learning will be reevaluated and revised. As the result of discoveries in electronics, education will become cheaper and more practical if it moves out of the schools .... and into the home or neighborhood center" (p. 6).

The telecommunications revolution is steadily progressing. Joseph (1979) indicates that the future will bring computers that are smarter and smaller, have a reduced price per function, have an increased memory, and are "friendlier" to users. He suggests that, by 1990, computers will be tied to electronic libraries and that these systems will cost less to use than the energy required to travel from school to work.

Communications technology will affect not only education but also work. The characteristics of tomorrow's world of work will be influenced largely by new communications technologies. This will result in the demand for a new set of job skills that are different than those needed for success in the industrial era. Theobald (1979) suggests that the following skills will be required: skills to live happily and creatively with others, life-planning skills, decision-making skills, creative change skills, and skills in analyzing the need for stability versus change. According to Beane (1979), "It seems that tomorrow's workers will need specific skills as well as the ability to adapt to changing society. As jobs are constantly changing and evolving in the future so will the attitudes that workers hold" (p. 14).

One of the factors propelling the advance of communications technologies is their capacity for alleviating existing problems. These benefits will exert an influence on the nature of education. Joseph (1979) suggests that traditional education will continue to experience extreme stress because it is labor intensive and because of the rapid growth of knowledge. There is mounting pressure to increase productivity in education. This pressure will result in distributing the delivery of education along a lifelong learning continuum and in moving toward the electronic delivery of education, which may eventually displace schools.

Overview of the Publication

The trends that have just been described are familiar to adult, career, and vocational educators. The need is to begin to clarify their implications and to specify strategies for dealing with change. This publication is intended to provide an update on recently developed communications technologies, to describe the ways in which use of these technologies is changing the nature of work and education, to highlight specific applications of communications technology to education, and to suggest a values framework for influencing the ways in which communications technology will be applied to adult, career, and vocational education.

This compilation contains papers by four authors. Each author was invited to contribute because of a specific expertise. The first paper, "The Reshaping of Adult, Career, and Vocational Education by the Emerging Communications Technologies," is by Christopher J. Dede. Dede provides background on the ways in which communications technologies are changing the world of work, and draws implications from these changes for required worker skills. Although some workers will need only lower level skills in their jobs, in most cases the machine/human work environment will require individuals to use higher order cognitive, professional, and affective skills. In education, communications technologies can reduce the cost of instruction, provide a means for dealing with new content that was previously too expensive to address, and improve the quality of research on the learning/teaching process. Dede provides an enumeration of content/skill areas that can be delivered using specific, emerging communications technologies. This paper also describes new educational markets that are developing due to the demand for lifelong learning, particularly by the adult population, and suggests that communications technologies can provide a means for delivering alternate learning experiences to meet these demands.

Frank W. Norwood reviews developments that will result in the home becoming a telecommunications center, in his paper, "Recent Developments in Telecommunications Technology." The major result of the communications revolution will be the development of the capacity to access not only entertainment, but also information and instruction, from the home and other community access points. This means that education will be available in many informal settings as well as in formal educational institutions. Norwood traces the communications technologies that will provide this access capability, including UHF, VHF, and cable television; decoder devices such as closed caption, teletext, and viewdata; Instructional Television Fixed Service and Multipoint Distribution Service; cassette and videodisc recorders; direct broadcast satellites; and microcomputers. The author cautions that although the survival of specific technologies will depend on market response, there is no question that the capacity to transmit information and educational services directly to the home will be increased greatly in the near future.

Jo Ann Harris-Bowlsbey addresses "Educational Applications of Computer Technology." Her paper focuses on three questions: (1) How can educators be trained to use communications technologies? (2) How can computers assist individuals in career decision making? and (3) How can computers be used to support instruction? Teachers need both preservice and inservice training to prepare them to assume the new role of instructional manager and developer. Difficulties may arise because this new role will require individuals with career interest patterns that differ from those of traditional teachers. New teacher selection criteria may be needed. Computers have the capacity to individualize instruction, provide instruction to large numbers of individuals, and tailor instructional modes according to the individual's learning styles and achievement levels. A major application of computers has been in the area of computer-assisted guidance systems which support the career planning process. This paper describes the different types of career planning systems and reviews the results of research that has been conducted in this area over the past fifteen years. Harris-Bowlsbey also stresses the tendency of communications technology to blur the lines between school, home, the work place, and the community. The home will become a significant learning setting, as will the community. Professional educators will need to respond to this trend.

Katy Brown Greenwood addresses the value and philosophical issues related to the future of vocational education in her paper, "A Philosophy to Guide the Use of Communications Technology in Vocational Education." She suggests that we must study alternative futures that futurists have portrayed, and must begin the task of reexamining the value and factual bases that will clarify characteristics of the preferred future. Using Frankena's (1974) model for analyzing educational philosophies, Greenwood reviews the historical basis for current vocational education philosophy and analyzes the changing trends that will influence the future philosophy. Based on this analysis, she suggests that the traditional outcome of vocational education, vocational competence, needs to be broadened, since required worker skills will shift from loyal obedience to such skills and attitudes as objectivity, evaluative and innovative skills, and long-term planning skills.

Summary of Findings

Although the four papers presented in this compilation contain quite different perspectives of the effects of communications technologies on adult, career, and vocational education, the following questions can be used to summarize the information presented.

Who will direct the development and application of technology? To influence the development of technology, there must be an image of a preferred future. Greenwood suggests that a reexamination of the values and philosophy that have guided vocational education must be completed in light of future trends information. Using this process, she has taken a step toward specifying this revised philosophy. Norwood presents a different viewpoint, indicating that the survival of specific technologies depends on their acceptance within the marketplace. Since extensive marketing is required to support the development and mass production of a technology, those technologies that are not widely accepted will not survive. Both Dede and Harris-Bowlsbey stress the importance of increasing educators' ability to influence the development and application of technology. Educators need to learn about the capacity of technology, to become involved in setting standards for and developing software, and to review their role in light of the contributions technology makes to the instructional process.

How will communications technologies reshape the goals of education? All four writers agree that communications technologies are creating rapid change in the school, home, work place, and community. Dede indicates that, from 1949 to 1965, eight thousand occupations disappeared while six thousand new occupations were developed. These technologies are not only creating new occupations, they are altering the way humans function. The work setting is a human/machine interaction where machines are increasingly performing lower level functions previously performed by humans. Most of the writers agree that this will require not only changes in specific occupational skills but also, more important, changes in general skills. Areas that will become important are higher order cognitive skills, flexible and creative decision-making skills, and group membership skills. In addition, rapid changes will create a need for frequent retraining, thus increasing the demand for lifelong education.

How will communications technologies reshape the delivery of education? Communications technologies can provide many of the functions previously performed by educators. Earlier work focused on lower level functions such as information dissemination and drill and practice. However, communications technologies are now being used to deliver instruction that (1) simulates complex, real life situations; (2) provides instructional management processes such as assessment, alternate learning activities, and evaluation; and (3) parallels educator-student interactions designed to teach more complex skills such as career decision making. Another major characteristic of the instructional capabilities of communications technologies is their capacity to provide access to education at points other than in the schools. Most striking is the increasing telecommunications capacity of the home. Although educators have until now controlled the quality of education because its delivery was limited to educational institutions, they will have less control in the future.

How can educators ensure the quality of applications of communications technology to education? There is little resistance to the development of communications technology. While specific technologies may not receive wide acceptance, overall developments will continue. This means that the question is no longer "Do we want communications technology?" Rather, the question for educators is "What strategies are needed to ensure the quality of instruction delivered through these technologies?" It is clear that, even if educators resist technology in formal educational settings, applications will proliferate in nonformal and informal settings. Educators need to move into the mainstream of policy development at the national, state, and local levels, to formulate and endorse standards that guide the development of educational applications, and to cooperate with other public and private sector institutions to develop joint standards for the use of technology.

How will communications technology change the role of the educator? As with other occupational areas, the use of communications technology will require higher level functioning by educators. Educators will need to become instructional developers and managers. They will need to acknowledge the influence of education that is available in the home, community settings, and the work place. These changes require both preservice and inservice training that focuses on such areas as knowledge of emerging technologies, criteria for ensuring quality in instructional programs that use communications technology, skills in developing software for instructional systems, and instructional management skills. In her paper, Harris-Bowlsbey suggests that some educators may have difficulty making this transition because their interest patterns make many of these new functions unsatisfying. Teacher education institutions need to reexamine admissions criteria to make them more congruent with the realities of this new educator role.

Future Directions

The purpose of this compilation is to provide an overview of recent developments in communications technology and to suggest how these developments will change the nature of adult, career, and vocational education. Its goal is to provide awareness and to highlight issues. Future publications need to focus on the following specific topics that grow out of these issues:

- Standards for the development and use of communications technologies in adult, career, and vocational education
- Models for coordinating learning in the school, home, community, and work place
- Analysis of new instructional content areas that can be delivered using communications technologies
- Emerging occupational competencies required in the work place
- Parents as educators in the home telecommunications center
- Professional development strategies to help educators adapt to their changing role.

It is hoped that this compilation will stimulate an interest in these areas.

THE RESHAPING OF ADULT, CAREER, AND VOCATIONAL EDUCATION BY THE EMERGING COMMUNICATIONS TECHNOLOGIES

Christopher J. Dede
University of Houston at Clear Lake

Recent and largely unanticipated breakthroughs in communications technologies seem likely to alter American work places and communities over the next several decades. Such a shift will change the needs of students in adult, career, and vocational education in a dramatic fashion. Moreover, these new technologies offer the potential to expand greatly both the range of methods used to teach occupationally related skills and the size and diversity of the clientele who can be reached by educational delivery systems.

The Emerging Information-based Society

As civilization becomes more complex, accurate and accessible information becomes increasingly important to economic prosperity (U.S. Congress 1981). Daniel Bell (1973) argues that the United States is entering a "post-industrial" period, in which—

- services supplant manufacturing as the major source of employment;
- information serves as a resource, a production factor, and a commodity;
- economic growth is largely predicated on scientific discovery and technological invention.

Emerging communications technologies are the cause of at least two major types of occupational shifts. First, a new tier of industries is emerging to become the heart of the information-centered economy. Two sectors of these industries can be identified:

1. The primary sector deals with the producers of telecommunications hardware and the generation and sale of information. It includes diverse groups such as the computer and communications industries, typewriter manufacturers, newspaper publishers, and film producers.

2. The secondary sector is composed of internal information services and products within an organization, e.g., internal accounting and production management and inventory control systems (Porat 1976).

Second, the emergence of an "intelligent work place" in traditional sectors of the economy—with microprocessors incorporated into tools and information management/telecommunications systems on the desk of every professional or technical employee—will create massive shifts in job roles (Evans 1979). This "new industrial revolution" will eliminate many lower level skill jobs while simultaneously creating new occupations that demand intensive, higher order cognitive functioning. Combined, these two shifts in the economic sector mean that few employees at the end of this decade will have jobs that are untouched by the new communications technologies.

America cannot afford to fall behind other countries in making these transformations to a new industrial base. Already, the United States' position in the international marketplace is threatened by the lead of West Germany and Japan in technology and human productivity (Conant 1979). Between 1970 and 1977, the increase in gross national product (GNP) per employee was 38 percent in Japan, 25 percent in West Germany, 23 percent in France, 14 percent in the United Kingdom, 12 percent in Canada, 12 percent in Italy—but only 8 percent in the United States (O'Toole, Brousseau, and Ralston 1979). In the past several years, the rate of increase in the United States has been nearly zero.

While many factors have been cited as explanations for lowered American productivity (Denison 1979), increasing the amount and efficiency of worker-related education seems central to improving the national economic and defense situation (Molnar 1980). Otherwise, the transition to an information-based society will not bring the return to affluence that Americans expect and desire.

Changes in the Work Place

The impact of information technology on occupational skills has been great since World War II. From 1949 to 1965, about eight thousand occupations disappeared from the United States labor market (due largely to the spread of automation); more than six thousand new occupations developed over the same period (Abbott 1978). Since these figures were compiled, with the amount of information processing that can be done per unit time and with costs doubling every two years, the processing capabilities of computers have increased by a factor of 256!

Many workers now must retrain three or four times during their careers because of rapid technological advance. For example, the electrical industry is experiencing such rapid change that about 10 percent of its technical knowledge becomes obsolete every year, and the electrical workers' union has fifty-seven full-time members constantly updating its textbooks (Goldstein 1980). With the new communications technologies causing an industrial transformation, during the next two decades many occupations may become so transient that complete retraining will be required every four to five years.

The advent of the microprocessor will increase the already fast pace of technological change to a frenzied pitch. Microcircuitry can replace hundreds of moving parts, redefining and reducing the number of jobs in industries such as cash register production and watchmaking. Robots will alter the environment of the assembly line, changing industries such as energy equipment manufacturing and weapons production. Printing, textiles, metal and plastic fabrication, instrument engineering, electronics, shipbuilding, and aircraft fabrication are illustrative of the range of industries likely to be affected. Communications, chemical/petrological, geological, and medical industries will undergo sweeping alterations (Norman 1980).

The manufacturing industries are not alone in facing the coming tide of new information technology applications. The service sector of the economy is also affected. Insurance agents, bank tellers, mail carriers, draftspersons, programmers, secretaries, cashiers, and sales clerks are examples of those in the service industries whose jobs may change. The skill shifts at upper managerial and administrative levels will be even more profound, as new communications channels and information synthesis systems redefine professional roles (Feldman 1981). The "half life" of advanced degrees—already only five or six years for many areas of engineering—will dwindle for the whole spectrum of business and technical personnel.

The overall magnitude of occupational transformation—between the incorporation of microprocessors into tools and the emergence of new tiers of information industries—will be comparable to the industrial and agricultural revolutions. The immediate effects on society will be greater and more disruptive than even these two historical shifts, because the time scale will be compressed, not to centuries or generations but decades. Societal resistance to such sudden changes will be overpowered by desires for economic resurgence and global preeminence.

Fully half the occupations will begin to alter by 1990—and then the oncoming revolution in biological technologies (e.g., recombinant DNA applications) will begin to have an impact on occupational roles. Work-related education must change swiftly and proactively to meet these emerging needs (Ruff and Shylo 1981).

Altered Occupational Skills

Some questions exist as to the specific ways in which the new communications technologies will change job roles. For example, some argue that "intelligent" tools will allow workers to be quite unskilled and hence will obviate the necessity for much occupational training. One example of such a situation is that of McDonalds: sales personnel need only find and punch the pictures of hamburgers, fries, shakes, and so forth on the electronic cash register, and the machine calculates the total bill and dispenses change. Since the food is preboxed and color-coded, no higher order cognitive skills whatsoever are required to perform such a job!

However, a multitude of job roles will emerge, combining skills used in word processing/text editing/information management positions. One such professional, properly trained, can do the work of five clerk-typists. The employer can pay this person, known as an information synthesis specialist, three times what a secretary makes, purchase the necessary equipment, pay for training, maintenance, and so forth, and still save money. A great many higher order cognitive and professional/affective skills are required of the employee, since the machine will not simply be used as a typewriter that makes corrections electronically.

A second issue concerns what types of complex skills workers will need to use "intelligent" tools. A naive conception is that universal technical literacy will be required, with each employee fluent in computer languages, engineering jargon, and mathematical constructs. While such abilities will be in demand during the "new industrial revolution," most jobs will not require these types of knowledge.

In actuality, the work place will become a set of human/machine partnerships, in which the device will accomplish what it can and the person will supplement what microprocessors cannot be programmed to do cost effectively. Information-based tools can be constructed to do technical things well, but they, unlike humans, are not skilled at being flexible, creative, or at making decisions given incomplete information. The capabilities of communications devices for complex pattern recognition, evaluation, and synthesis are also quite limited. Hence, the "new basics" required of workers—and, in a broader sense, the emerging altered definition of human intelligence—will center on largely nontechnical skills that in many ways resemble those taught in a liberal arts, general education curriculum.

A third issue is that changes in the attitudinal and institutional structure of the work place will inevitably accompany the incorporation of communications technologies into job roles. Not all stagnation in productivity can be attributed to inadequate training or to outmoded capital equipment. A predominant "hate work" mentality and poor worker management approaches also are significant problems.

Attitudes of dislike for work and indifference to quality of performance often stem either from workers not feeling challenged and interested by the job or from a sense on their part of unnecessary stratification and exploitation by the employer. "Intelligent" tools, which remove the routine and boring aspects of many occupations, will aid in combating worker ennui, but may increase employee alienation if sufficient interaction with co-workers is not retained or if increases in salary and stature are not concommitant with new skills acquired. In Europe and in Japan, more technically sophisticated work forces often have demanded increased "economic democracy."

Economic democracy is a movement committed to increasing the involvement and commitment of the worker to the employer by enhancing the worker's participation in decision making (Levin 1979). Traditional rewards of wages, possibilities of promotion, and steady employment (all currently becoming difficult for employers to offer) seem to be less important when workers have an increased level of satisfaction and motivation from shared control over the work environment. Joint decision making can take the form of teams of autonomous work groups, codetermination on governing boards by representatives of both management and labor, and even worker self-management via elected councils that make all major policy decisions for the firm.

As with the communications technologies, the implementation of some form of economic democracy in the American work place would require changes in the skills of the labor force. These would include enhanced abilities to participate in group decision making, the capacity for increased individual decision making, cooperative skills, and the ability to give and receive training. Such skills will require increased work-related education. In turn, workers with augmented responsibilities in decision making might well choose to increase the amount of job-related training available, as education may be perceived as an essential component in maintaining the environment of an economic democracy.

Broader Societal Shifts

The family and community lives of workers will also be dramatically affected by the new information technologies (Wise 1980). The demarcation between job and personal life will be weakened as communications devices enable occupational roles to be performed at home (Coates 1981). Interpersonal relationships will be affected by an increase in communication via machines and a lessening of direct interaction. The effective size of families and communities will grow as interaction at a distance becomes cheaper and easier. The demands of continual retraining will reduce the time and energy workers have for other facets of their lives, until increased affluence allows a reduction in working hours. These illustrate the multiplicity of challenges that adult, career, and vocational education will confront.

Moreover, the ways in which the new communications technologies affect work-related training will be shaped by all the other societal forces interacting in the 1980s (Institute for the Future 1979). Demographic, economic, and political developments will be influential in determining how and when these devices are implemented (Lewis 1980). It does seem likely that economic pressures will compel a rapid and massive adoption of information-based tools despite the traditional inertia of the work place (Miernyk 1979), although the array of potential policies that could affect these decisions is large (Ruff, Shylo, and Russell 1981). Even in education, traditionally very resistant to new approaches, these communications devices will reshape job roles. The sectors of education likely to be affected first are adult, career, and vocational education.

Breakthroughs in Communications Technologies

Occupationally related education has always been constrained by the cost of information.

- A printed page has about ten thousand bits of information and costs about $0.03.
- A colored slide has about two hundred fifty thousand bits of information and costs about $0.50.
- A half-hour color motion picture has about ten billion bits of information and costs about $700.
- Organized real world environments such as technical labs and field trips are even richer in the amount of information available, but also much more expensive. Many types of job-related education are limited by the costs of such experience. (Lipson 1981)

The emerging communications technologies offer a means of dramatically reducing the cost of information in the curriculum, while simultaneously enhancing interaction and convenience (Stakenas and Kaufman 1977).

The power of the emerging communications technologies makes major cost reductions possible. The personal computers available today for less than one thousand dollars are twenty times faster and cost two hundred times less than state-of-the-art computer systems available in 1958 (Licklider 1979). The videodiscs, now being marketed for about twenty dollars each, contain about fifty thousand images of video information. Digital videodiscs, which will be operational by the mid-1980s, will be able to use these images to store about ten billion bits of information (equivalent to one thousand books). An electron beam device, "writing" on a small wafer of semiconductor material, can store about one hundred billion bits—roughly ten thousand books. Magnetic bubble memories are expected to condense even larger amounts of information; perhaps the entire Library of Congress will be stored in a book-sized container.

Optical fibers the diameter of a human hair can carry more than one hundred million bits per second (ten books per second). Laser printers, controlled by computers, can produce several pages of high quality text and graphics per second. Satellite telecommunications advances allow the delivery of this volume of information rapidly and cheaply to individual households, in either text or video form.

By the early 1990s, computers will be approximately thirty times more powerful than at present. A complete microcomputer system the size of a display case will have the storage capacity for a library at least the size of twenty-five major reference works (Kay 1973). The top part of the case can contain a full-color screen that displays text, high-resolution graphics, and pictures; a complete keyboard and speech synthesizer can be stored in the bottom. The computer core of the device can have the memory and the program needed for sophisticated processing of student work (answer checking, searching for error patterns, tutoring, coaching, mapping student knowledge, speech recognition, branching based on errors, and so forth).

Two-way, interactive transmission of information via cable systems linked to home television sets will be almost universal. This will allow for "narrow-casting" capabilities or the use of "packet switching," through which forty households simultaneously tuned to the same channel could receive, at their individual discretion, forty different programs. A single large computer could interact with hundreds of homes all at the same time, via timesharing strategies.

How will these advances enhance the instructional process in work-related education? Briefly, the computer, the videodisc, and communications networks have the potential to—

- improve instruction in conventional vocational, career, and adult education subjects;
- allow the efficient teaching of types of knowledge and skills previously too expensive to include in the occupational curriculum (e.g., sophisticated laboratory procedures and instrumentation);
- improve the quality of research into the teaching/learning process;
- increase the size of groups taught without increasing costs or adversely affecting quality.

The Promise of Information Technology in Education

Historically, technological devices have been of little aid in occupationally related education because they were capable of only a few, very basic teaching functions (such as drill and practice), compared to the wide range of instructional skills used in teaching the adult, vocational, and career education curriculum. Between now and the end of the 1980s, developments in the power, cost, speed, and memory of the information technologies will create a wide range of new educational modalities, such as the following:

- **Hand-Held Computers**
  - — drill and practice
  - — presentation of simple material, with questions to test assimilation
  - — response to student-initiated questions on a specific topic
  - — simple games that build basic remedial skills (such as spelling)
- **Microcomputers**
  - — complex games to build higher order skills (such as advanced math)
  - — simple interactive simulations (such as modeling lab equipment)
  - — simple "microworlds" (e.g., what would happen if gravity behaved differently?)
  - — voice input and output
  - — computer art and music
  - — word processing and spelling/grammar correction
  - — authoring programs (enabling faculty to create instructional packages)
  - — computer-managed instruction

— information management, data retrieval, and recordkeeping

- **Mainframe Computers**

— complex simulations and microworlds

— complex presentation of data bases (e.g., three-dimensional tour through an architectural structure)

— sophisticated electronic library

- **Computer Networks**

— electronic mail

— computer conferencing

— transfer of large data bases

- **Mass Telecommunications**

— instructional delivery to multiple extra-school settings (one-way or interactive)

— dramatic, vicarious experiences (with corresponding affective overlay)

— simple models of skilled performance (e.g., titration, word processor usage)

- **Interactive Videodisc**

— complex models of skilled performance (e.g., electronics diagnosis and repair, surgery)

— surrogate travel (such as a trip through an art museum or a factory with the student controlling speed and angle of view)

This list is incomplete, and many of the labels are too narrow to convey the full spectrum of capabilities possible (Dede 1980). It will take a long time for educators to master completely the usage of this range. Nonetheless, these sample modalities illustrate how the instructional properties and attributes of these devices can be matched to the learning process, thereby enhancing the efficiency and effectiveness of occupational education.

As a result of these new modalities, types of knowledge and skills previously too expensive to be included in work-related education can be taught on a cost-effective basis. Words, symbols, and line drawings are cheap and powerful (in both information and monetary terms). Historically, the vocational curriculum has tended to emphasize subjects that can be taught primarily in this manner (Lipson 1981). One difficulty that such an approach poses is that words and symbols are good for teaching descriptive and declarative knowledge, but not as good for teaching complex procedural skills such as laboratory procedures, medical skills, advanced writing, equipment troubleshooting, and instrument usage. Occupationally related education has tended to teach "what" rather than "how," but changes in America's industrial base and emerging predominance of professional and technical jobs are forcing an emphasis on "how."

The functions listed previously under "Microcomputers," "Mainframe Computers," and "Interactive Videodisc" indicate an incipient capability to teach complex, higher order procedural skills cheaply via technological simulation. In fact, these types of knowledge are characterized by a limited range of "right answers," and are particularly well suited to being taught by instructional devices. As a result, students will become better able to communicate, to organize information, to formulate strategies when presented with complex real-world phenomena, and to emulate expert performance. Such skills will increase the demand for trained personnel in the work place.

Also, hand-held computers (with hardware costing about twenty dollars total and replaceable memory chips available for less than a dollar apiece) can replace or supplement textbooks, reference works, and handouts. Speech input and output can be added to these devices without greatly increasing their cost. Using such technologies, students can interactively learn basic work-related material at their convenience, tailoring the delivery system to their learning style and reducing both individual and institutional investments in unalterable printed materials. Costly contact with human instructors can then be targeted to answering advanced questions and teaching sophisticated cognitive skills.

Finally, the quality of research into the teaching/learning process can be greatly improved by using communications technologies for instructional delivery. All these devices can unobtrusively and cheaply measure key variables such as student time on task, response time to questions, percentage of errors in answering items, pattern of mistakes made, and tutoring sequences chosen. As a result, information previously unobtainable about individual performance can be garnered as a byproduct of instruction without elaborate human recordkeeping. Further, as teaching devices are tailored to learner responses and as alternative instructional modalities are tested, the success or failure of different approaches will provide invaluable insight into the basic nature of higher order human learning.

From such research, an applied educational science can emerge. Cognitive psychology, ergonomics (studies of human/machine partnership), and educational research all would benefit greatly from the fundamental knowledge thus gained. In turn, the applications of these new insights could be used in industrial training and adult education. Comparable gains in educational theory, using data collected solely from human instruction, would be prohibitively expensive; thus, the emerging information technologies offer the promise of a fundamental breakthrough in understanding the workings of the mind.

Altered teaching and research strategies are by no means the only impact of the information technologies on adult, vocational, and career education. Many more shifts in instructional practice are likely as a result of the new communications devices than can be detailed here (Dede 1981). One important issue that merits discussion is the increased numbers of students who will need job-related education in the 1980s. Previous sections of this chapter have indicated that most workers will require some form of retraining. How, given current realities, can this large group of potential clients be reached?

New Delivery Systems—New Markets

Mass telecommunications and computer networking have the capability of greatly expanding the number of students served by vocational, career, and adult educators. Demand for work-related training has always been limited by constraints on the lives of older, working students. Historically, to allow even part of the working population to attend instruction, institutions have had to provide classes at night or on weekends at locations other than the campus; altered admissions requirements and formal entry standards; and special services such as lower fees, special counselors, financial aid, business and job placement, expanded office hours, and child care. While expanding occupationally related education has been seen as an important priority in America's economic productivity, the difficulties of providing increased training using conventional instructional methods have been formidable.

As indicated in the list of modalities earlier, the new communications technologies offer capabilities that may ameliorate some of these problems for adults and workers. Interactive delivery of highly specialized instruction to home or work place settings will be easy and cheap by the late 1980s. The more basic aspect of training can be communicated by devices (either hand-held or home-based) from which students can learn individually at their convenience. Computer networking offers the potential for better "cooperation-at-a-distance" strategies than education/industry partnerships have been able to achieve with more traditional forms of communication. Students can transact necessary business with different sectors of the institution without having to appear physically on the campus. Limitations on time, location, and individualization will be greatly lessened.

How many clients will be able to avail themselves of educational services as these historic constraints are removed is not certain, but—given the magnitude of change in job roles that America is facing in the next decade—it seems very probable that a high percentage of all workers will wish to receive work-related training if it is reasonably convenient.

How large a potential demand could develop? Goldstein (1980) cites a figure of 1.378 million eighteen-year-olds in secondary school vocational curricula in 1976; this represents 32.5 percent of that age cohort. By way of comparison, the National Center for Education Statistics (Grant and Eiden 1980) indicates an enrollment of 8.98 million in federally funded vocational education secondary school classes in 1976 (60 to 65 percent of all secondary school students). This figure includes enrollments in agriculture, distributive, home economics, health, office, technical, trade and industrial, and "other" courses. Whatever the exact size, vocational/technical education is clearly now a major type of instruction in the secondary schools and probably will not greatly expand its current percentage of that population no matter what delivery systems are used. However, the size of this specialized market means that courseware manufacturers may well target sophisticated instructional technology packages to this group.

Estimates of enrollment in noncollegiate postsecondary schools in 1976 range from 1.399 million (Grant and Eiden 1980) to 3.066 million (Fraser 1980), so the uncertainty in such figures is high. Over 60 percent of the women and over 80 percent of the men enrolled were employed full time, with many also attending school full time. A greater percentage of the working population might well choose to receive training from these vocational/ technical institutes, technical schools, business/office schools, cosmetology/ barber schools, flight schools, trade schools, design institutes, hospital schools, allied health schools, and the like if alternative technologically-based delivery systems were available.

On the collegiate level in 1976, community colleges enrolled between two hundred forty-three and three hundred fifty-two thousand students around age twenty in occupational curricula (about 70 percent of all associate of arts degrees that year) (Grant and Eiden 1980). Significant numbers of the noncollegiate postsecondary students in vocational schools might be lured to community colleges if more flexible forms of instructional delivery were utilized. Both competition and the total size of this market may grow as the new communications devices become more prevalent.

Continuing, work-related education provided by employers encompasses a less formal and less understood market. Quantitative data in this area are generally sparse, and estimates vary widely. It appears that formal training is currently provided by less than half of all firms, but by more than 80 percent of large firms. The number of workers involved in formal training in any year is about one in five in big firms and a lesser proportion in smaller enterprises (Fraser 1980). Cost estimates have ranged from one hundred billion dollars per year (formal and informal training, direct and indirect costs)—which was 12 percent of all wages and salary payments in that year—to as small as three billion dollars per year. The majority of researchers give figures of ten to twenty-five billion dollars per year. Continuing professional education and labor-sponsored training would add to the size of these estimates.

This is a market likely to expand considerably with the advent of the "new industrial revolution," and most employers will be seeking methods of retraining without causing major inconvenience for either firm or employee. Corporations have historically been reluctant to implement extensive inhouse education programs, preferring to contract these services, but in recent years this trend has begun to change. Whether the new communications devices intensify the movement away from services delivered by educational institutions will probably depend on the speed with which vocational educators adopt instructional technologies tailored to worker needs and constraints. Certainly, the size of the potential market for high quality technology-based training is enormous, and some group—public or private—will arise to fill this need.

Adult education can be categorized as either basic instruction (elementary and seoondary school) or informal learning (community associations, various types of private instruction, and self-created learning experiences). In 1977, 1.686 million students participated in adult basic educational programs targeted to elementary and secondary school certificates and to preparation for the General Educational Development (GED) tests (Grant and Eiden 1980). This is only a small percentage of the eligible population for literacy programs; between 40 and 60 million adult Americans seem to lack either basic reading and writing skills or the competencies to perform the common tasks of adult life, or else failed to finish high school.

Robert Stump, while at the National Institute of Education, estimated that only 5 percent of those adults having functional literacy problems were enrolled in formal adult basic education programs.* With the "new industrial revolution," more demanding types of required literacy will cause this problem to worsen even as the communications technologies open up possibilities for large scale, home-based training of such students. Tough's (1978) work in adult informal education indicates a still larger potential market for educational services. Crosscultural surveys indicate that 90 percent of adults conduct at least one major learning effort per year, with the median person conducting five separate projects per year, averaging one hundred hours each. About 20 percent of these projects are planned by someone paid, trained, or designated to facilitate the learning; almost all other projects are designed by the learner. The communications technologies offer the potential for delivering tailored, informal experiences to this very large group of potential clients.

The new information technologies can provide alternative forms of delivery that reduce the constraints on learning that many adult and working students face. Often, these media demand modifications in the instructional process to be effective, but the capabilities described earlier seem to be powerful enough to render even long-distance learning interesting if properly applied. The new revenues and student enrollments such instructional systems would generate could more than pay for the capital costs and retraining needed to initiate these technology-based approaches.

*Unpublished communication, 1980.

Conclusion

America is at a moment in history when new student needs and new methods of educational practice are developing simultaneously. The rewards for successful innovation—both in education and in the work place as a whole—will be high; the consequences of failure or stagnation may be disastrous. Vocational, adult, and career educators find themselves on the leading edge of this transformation; they are in a position to set a strong model for others to follow.

RECENT DEVELOPMENTS IN TELECOMMUNICATIONS TECHNOLOGY

Frank W. Norwood
Joint Council on Educational Telecommunications

Various writers have given it a hundred names. Marshall McLuhan calls it "the global village." Harvard sociologist Daniel Bell terms it "the post-industrial society." Madison Avenue ad-man/philosopher Bill Donnelly's phrase is "the emerging video environment." It is also called "the information age," "the learning society," "the communications revolution," and "the microelectronics era." In France, they say "telematique." Whatever you call it, it is already well begun, and it is taking us on a dizzying trip to unknown destinations.* Half of what you have read about telecommunications developments is not true, but only time will tell which half. But some predictions are safer than others, and predictions about that part of the future that is already here are the safest.

Television: VHF, UHF, and Cable

Focus attention, as millions of Americans do for seven or eight hours a day, on the television set. In the late 1950s, the most viewed programs came from the networks, via local VHF stations. After 1964, television sets had another dial, one with channel numbers running from fourteen to eighty-two, and in time viewers were offered other choices in addition to large, commercial networks. Public television could never have developed into a national service without UHF, nor could there have been the growth of independent stations, presently the fastest growing segment in commercial television.

In the same period, something else was added, at least to television sets in some communities: the coaxial cable that connected them to community antenna television (CATV). In its earliest days, cable television brought only a few signals to communities that had had few or none before, but in time cable television began importing signals from big city stations many miles away (Sloan Commission 1971).

In 1975, a Time-Life subsidiary, Home Box Office (HBO), made a daring move. HBO was already successfully providing cable operators with a pay channel of uninterrupted, uncut movies, but expanding the system beyond its New York hub involved either expensive microwave circuits or the shipment of prerecorded tapes to distant systems. HBO signed a multimillion dollar contract with RCA for two channels on RCA's Satcom I satellite in the hope that cable operators, tempted by the additional income that pay television could bring them, would invest in the necessary earth stations to receive HBO programming. No small investment, it required about one hundred thousand dollars for the hardware, site preparation, and engineering and legal fees.

This gamble paid off handsomely, not only for HBO, but for the cable industry. Other cable programming services, such as the Christian Broadcasting Network (CBN), found it

*See for example: Bell 1973; Donnelly 1977; Handel 1967; Hutchins 1968; McLuhan 1964.

advantageous to get on Satcom I, at which a growing number of cable earth stations were pointed. Cable operators found that they could add the electronics to receive CBN and other programs for modest incremental costs, once the basic earth station was in place. The cable industry discovered a magic cure for the "blahs" that had plagued cable since 1971: new programming, movies, sports, religious programs, family fare, even soft-core pornography, not available to those unfortunates without a cable connection ("Communications Satellites" 1979). When cable television prospered in Nassau County, Long Island, where viewers could get a dozen or more TV signals over the air, it became evident that what was selling cable was no longer improved reception and a few distant signals.

More programming requires more channels on the cable; more cable channels invite entrepreneurs to offer more programming. The pace has been quickened by changes in earth station regulation and technology that have brought the price of "TVROs" ("television-receive-only") down from one hundred thousand dollars to less than twenty-thousand dollars. At this writing, there are more than forty satellite-delivered program services, and the promise of again that many more. Cable systems being developed in major cities will offer more than two hundred channels. Although that number includes "loops" (separate cables) for business and local government, the availability of one hundred channels to homes will become common. Cable systems' "head ends" are sprouting multiple earth stations, or newer models that can receive programming from several satellites simultaneously.

These developments are converting the television set from an entertainment to an information device. The new services include live coverage of the U.S. House of Representatives. The Appalachian Community Service Network transmits a schedule of instructional programs, formal and informal, from reading readiness for preschoolers to car care and college courses for adults. Ted Turner's Cable News Networks 1 and 2 offer twenty-four hour per day news coverage, and they have competition from Satellite News Channels, a new joint venture of ABC and Westinghouse. The new Financial News Network uses a satellite to send a steady stream of market information to cable systems and broadcast TV stations.

Not all of this information is available in the form of conventional television. "Alphanumerics" is the fashionable jargon for letters, numbers, and punctuation that, when we put it on paper, is known as "print." The Weather Channel combines national and regional weather forecasts with localized alphanumeric displays. Dow Jones and Reuters are among the information companies offering alphanumeric services via satellite and cable. At the local level, cable may display the day's best buys in a comparative array of supermarket prices, as Warner-QUBE has done in Columbus, Ohio; carry classified ads that list the meetings of church and community groups; or list job openings or real estate offerings. In Louisville, Kentucky, and elsewhere, local newspapers are acquiring one or more cable channels to test the waters in "electronic publishing."*

Decoders for Closed Captions, Teletext, and Viewdata

So far, we have counted three wires providing input to the family TV set: the VHF antenna, the UHF antenna, and the cable, which actually replaces the other two. Other inputs are possible in today's emerging video environment. For the hearing impaired, the "closed caption decoder" provides additional alphanumerics. Developed by the Public Broadcasting Service under grants from the Department of Health, Education and Welfare and sold on a nonprofit basis by Sears,

*For a monthly update on satellite services for cable television, see *CableVision* magazine's "Cable Stats" section.

the decoder converts digital information (sent during the vertical interval between television pictures) into captions displayed across the bottom of the TV screen.

In some cities, another input could come from a teletext decoder, a device quite similar to the caption decoder. Like closed captions, teletext is transmitted during the vertical interval, that black bar that separates the bottom of one picture from the top of the next. Teletext is different from closed captioning in two significant ways: the text has nothing to do with the TV program being broadcast, and the decoder contains a recording and storage device, known as a "frame-grabber." About one hundred fifty different "pages" or frames are transmitted in a constantly repeated cycle. When you turn on your decoder, the conventional picture and sound disappear, and are replaced by Frame 1, which is a menu or table of contents. Since not all the frames can be listed on Frame 1, a branching procedure is used. Frame 1 may direct you to Frame 40 for "Sports." Pressing "four-zero-go" on your hand-held control unit will cause Frame 40 to be recorded the next time it comes around, stored, and displayed on the screen. Frame 40 may give you the locations of sports subcategories. When you finally reach a story you want to read, you can use other buttons on the controller to advance or go back one frame at a time. News items are typically five or six frames in length. Teletext creates the capability of "reading" a television set.

Viewdata or videotex is another adaptation. Teletext is one-way; viewdata is interactive. Teletext is limited in its capacity by the cycle time—if the frame you request has just gone by, you may have to wait more than twenty seconds until it comes around again. Viewdata, on the other hand, transmits no frame from its computer memory until someone asks for it by sending an appropriate request over the telephone line, or back over the cable. Viewdata's capacity and flexibility are impressive, and so are the costs involved, but the world of teletext and viewdata is changing rapidly.*

Teletext (in a variety of incompatible formats from England, France, and Canada—although all but the British may be made compatible) and viewdata (the British have had an operational system for some tim) are here today. The big question is whether they will be here tomorrow, and that question is essentially one of consumer acceptance and economics. Videotex, to use the term that combines them both, is a medium looking for a mission, if not a message.

Instructional Television Fixed Service and Multipoint Distribution Service

Now add to the television set two more inputs. The Instructional Television Fixed Service (ITFS) has been in existence for twenty years without attracting much notice from the public at large. The Federal Communications Commission (FCC) has allocated microwave frequencies, far above the UHF band, for twenty-eight channels, in seven groups of four channels each, specifically intended for instructional purposes. School systems use ITFS for the over-the-air closed circuit distribution of classroom programs to the schools. Colleges and universities use ITFS to link remote campuses and to deliver professional education in engineering, business, and the health professions to part-time students in their places of employment. Little has been done yet to reach part-time students in their homes, but modern ITFS technology is capable of accomplishing that feat (Cooper 1967).

The second of this pair of inputs is from a Multipoint Distribution Service (MDS) antenna. MDS is a commercial service, technically similar to ITFS. At present, it is used primarily to relay

*For a good review, see "Teletext and Videotex" (1982).

HBO or other pay television fare to hotels, apartments, and homes in areas that have not yet been wired with cable. But the Microband Corporation of America, largest of the MDS operators, hopes that MDS will use twelve of ITFS' twenty-eight channels to provide a wider variety of services which also use return telephone circuits, such as interactive banking, shopping, security, and information services. ITFS and MDS services are available now, although ITFS-to-the-home is relatively untried, and MDS is only available at present as a single channel service.

Pay Television

Pay television represents yet another input to the home television set. The official name is Subscription Television (STV), and the broadcast stations that engage in STV are at present all UHF. STV requires a UHF antenna (most cable systems decline to carry Subscription Television stations) and a decoder to unravel the station's scrambled signal. In areas such as Los Angeles, where there are two STV stations, a single antenna will do, but a separate decoder for each station is required.*

Cassette and Videodisc

Another development is the videocassette recorder (VCR). The VCR records programs from all of the other sources—broadcast, cable, MDS, and so forth—subject to whatever legal restrictions are finally decided upon by the courts and Congress. The videodisc can only play back prerecorded material. There are two kinds at present, laser-optical and capacitance, with other systems under development. All present and promised systems are incompatible. Separate videodiscs, players, and inputs are required. The videodisc is a powerful device and potentially a significant educational tool, particularly that version of the laser-optical player which can display single frames, go forward or backward in slow or fast motion, and can seek out and retrieve information from among the 54,000 frames in a half-hour program. While the videodisc can capture both still pictures and alphanumerics as well as conventional video, 54,000 frames are definitely not equivalent to 54,000 printed pages, because of television's limited resolution. The same amount of information cannot be seen as clearly on a television screen as on the printed page.**

What the videodisc is capable of doing has been demonstrated in a number of laboratory experiments. According to Colonel James Lane of Ft. Belvoir, "We can combine the storage capabilities of the book with the interactive ability of the computer disc and the dynamics of the motion picture. . .and we can wrap it all up in a single videodisc." Lane ("Video Disc Update" 1978) anticipates that a single two-sided disc, with thirty minutes playing time per side, could carry a forty-five-hour course, combining fifty-one minutes of full-motion television with 16,200 frames of text. McGraw-Hill has developed as a pilot model a senior high school or college-level biology course in which the disc's thirty-minute side contains approximately twenty-six minutes of video selected from four McGraw-Hill films plus a two-and-a-half minute introduction. Of the remaining minute on the disc, about forty seconds are used for start-up instructions. With all but twenty seconds of the disc's running time accounted for, the remaining 600 frames are devoted to text—the equivalent of a fair-sized book.

*A recent article examined MDS, STV, and their potential influence in the Washington, D.C., market ("Able to Soar ......" 1982).

**For a comprehensive listing of the thousands of programs available on video cassette and videodisc, see *The Video Source Book*, 3rd ed. (1981).

At this point, it is difficult to predict the future of videodiscs. Their potential for education and training is evident, but their widespread use and affordability by those without enormous budgets will hinge upon the videodisc's success in the consumer market. The record to date is less than encouraging. Sales of players, particularly in the laser format, have disappointed their proponents, but RCA has discovered that the videodisc player owner's appetite for movies on discs exceeds market expectations.

Direct Broadcast Satellites

In the next few years it is probable that many homes will be adding a new input to the overburdened television set from a satellite antenna. In fact, as many as one hundred thousand homes (there is no accurate count) have such an input right now. These backyard earth stations, costing as little as twenty-five hundred dollars, first found a market among remote farmers and ranchers, but the market is spreading rapidly even to major metropolitan areas that already are well served by conventional TV. What homeowners with backyard earth stations are watching is satellite-delivered cable fare, plus stories being fed by the networks from their West Coast to New York facilities for inclusion in the networks' nightly newscasts. What the future will bring is a new generation of satellites with programming intended for home, school, and training site consumption—direct broadcast satellites (DBS).

The Federal Communications Commission has under consideration several applications from companies wanting to pioneer the new DBS industry. The first application was submitted by a subsidiary of the Communications Satellite Corporation (Comsat), and others were submitted from such industry giants as CBS, RCA, and Western Union. It will take some years before the new DBS satellites can be built and set in orbit, but Comsat and several others want to begin as soon as possible with an interim service by using existing United States and Canadian-owned satellites. If the regulatory hurdles can be cleared, DBS service could be a reality by 1984, and could have far-reaching uses in adult, career, and vocational education ("FCC Opens Skies to DBS" 1982).

Microcomputers

The final input to the home television set is the microcomputer. The full potential of the home computer has not been realized. Couple the home computer with the telephone as well as with the television, and a vast storehouse of information is unlocked, creating videotex on a grand scale. Such firms as CompuServe and The Source maintain large data bases that subscribers can access for an hourly hook-up charge. NewsNet, a new venture by the company that once owned the *Philadelphia Bulletin*, offers a variety of newsletters by various publishers on line. Through NewsNet, subscribers to the electronic edition need no longer wait until the United States Postal Service delivers the "latest" news. They can call it up electronically—telemetrically—on their TV screens the moment it is published. Further, they can "key word search" back issues for all recent stories on the topic of interest.

Summary

This brief catalogue of the "telematic society" is not futuristic, since all of these inputs are available now or will be available in the immediate future. On the other hand, this catalogue may be too futuristic because what can be built in the laboratory is not always marketable. Marketplace decisions will sustain or inhibit change. Unless viewdata, videodiscs, direct broadcast satellites, or home computers succeed in the marketplace, their potential benefits for education and training are not likely to be realized.

Adult, career, and vocational education will not be affected greatly by technology that is not widely accepted outside of education. Also, there is reason to temper our enthusiasm by recalling how successfully the educational establishment resists change. In thirty years, television has wrought great changes in American politics, family life, sexual mores, and other facets of our lives. But its impact on education, from kindergarten to graduate school, has been very small. It has been said that, if the use of all school- and college-related television ceased tomorrow, its disappearance would hardly be noticed.

That leads to the hypothesis that communications technologies may have greater impact outside of the traditional educational system. Peter Drucker (1981) states that continuing professional education, the fastest growing segment of education, is increasingly being provided by professional associations, management groups, business and industry, and proprietary groups using communications technologies. High technology companies like Texas Instruments are meeting the shortage of trained engineers by hiring liberal arts graduates and assuming responsibility for their technical education. If the British Open University, which depends heavily on televised instruction, is a precursor of things to come, communications technologies will find application in providing new means for delivering continuing education to those outside of the traditional college-age cohort.

In vocational education, new telecommunications probably will be both a delivery system of education as well as the subject matter. The new technologies will require new generations of installers, maintenance personnel, and repairers. On the other hand, solid state electronic devices used commonly in the new telecommunications have longer, more trouble-free lives than their tube-type predecessors. When something goes wrong, it is often simpler, faster, and cheaper to replace a whole circuit board or an entire device than to engage in the detective work of diagnosis and repair. These are facts that have still larger implications for vocational education.

It is important to acknowledge the growing trend for education to be delivered directly into the home and to be delivered in nonformal educational settings such as business and industry. This review of the capacity of the home television when linked with other devices is intended to highlight the current status of the technology. Although the survival of specific adaptations will depend on market response, there is no question that the capacity to transmit information and educational services directly to the home will be increased greatly. The formal education system will have little influence over these developments if the public demand exists. Several questions need to be addressed by professional educators, including: (1) How will educators redefine their role in light of these developments? (2) How can educators be involved in determining the nature and quality of information that is transmitted through this technology? (3) How can coordination between formal and nonformal education settings be increased? and (4) How can the new technology be applied in formal educational programs to strengthen both the content and process of education?

EDUCATIONAL APPLICATIONS OF COMMUNICATIONS TECHNOLOGY

Jo Ann Harris-Bowlsbey
Towson State University

The rapidly changing communications technology will have profound effects upon at least three areas related to adult, career, and vocational education. These areas include (1) how educators are trained to accept and use these technologies, (2) how computers can help students select vocational and educational options, and (3) how computers will be used to support instruction. This chapter addresses these three areas in some detail.

Training the Educator

The most difficult part of any decision or action plan is to create an awareness of the need for change. Lack of awareness is one of the major obstacles to the effective use of communications technology by the present generation of adult, career, and vocational educators. Meanwhile, the younger generation is becoming comfortable with this technology. Following the model of the early marketing campaigns for television, one of the major manufacturers of microcomputers is directing its marketing activities toward the nation's elementary and secondary school students. This company will provide a demonstration in a classroom, will host a field trip from a school, and is planning to give a microcomputer to every school in the nation. What effect will this kind of strategy have? Children and adolescents, already hooked on television and computer games, will have a level of computer literacy and acceptance that will lead them to expect every classroom and home to have a microcomputer and its associated technology. It is already true that many third graders have more knowledge and sophistication in microcomputer technology than do their parents or teachers.

What does this knowledge gap mean for the preservice and inservice training of educators? It means that there is a need for a major thrust in both preservice and inservice to help adults become more comfortable with technology. Developing this assurance is a difficult task for several reasons. First, many educators still fear that the computer and other technologies may replace them, even though there has been little basis for this fear. In the late 1960s, when computer-assisted instruction was new, predictions were made about its rapid spread and its impact on the number of teachers needed. Those predictions never came true. For financial reasons, the movement toward computer-assisted instruction never really succeeded. Where computer-assisted instruction was utilized, there were satisfactory gains in student learning, but the number of teachers needed did not decline. In fact, students came to teachers and counselors (in the case of computer-based guidance) with more questions, though these questions were at a much higher level of specificity than before.

It is difficult to predict the direction of the future as the power of microprocessors, videodiscs, and television equipment becomes greater and costs decline. Probably, communications technology will not significantly replace teachers, but it will change their role dramatically. Without any doubt, the first hurdle of preservice and inservice training will have to be an awareness of the impact of these sophisticated tools and an acceptance of them as powerful helpers in instruction.

A second problem in training educators is inherent in the personality traits of teachers. John Holland (1973) suggests that career choice is based on a matching of the personality type of the individual to the characteristics of the work environment. These six personality types are (1) Realistic (those who like to work with their hands and have skills such as mechanical reasoning and manual dexterity), (2) Investigative (those who like to work with their minds in abstract thinking and idea generation), (3) Artistic (those who spontaneously produce new and original art forms or ways to view or implement something), (4) Social (those who prefer to work face to face with people in order to help them, instruct them, or aid them physically), (5) Enterprising (those who work face-to-face with people in order to influence, manage, or sell them something), and (6) Conventional (those who work with data and paper to keep things functioning in a smooth and orderly way).

An effective teacher (or counselor) in the past has been a Social personality type, one who is very interested in working face to face with students to teach and influence them and to utilize good personal communication skills. Other personality characteristics of effective teachers are either Artistic or Enterprising. When teachers are asked to accept and use technology effectively, however, the Realistic personality type is required. This means that the introduction of technology changes the work environment and, consequently, changes the type of individual who will be successful and satisfied with the occupation.

The challenge is to retrain current educators and to select future ones who are able to combine seemingly diverse interests and skills. Teacher education programs must (1) increase teachers' awareness of the need to incorporate technology as a valuable instructional tool; (2) transmit a sufficient level of computer literacy to help teachers envision ways in which technology can enhance instruction; and (3) train teachers in the basic skills needed to design, program, and maintain computer-assisted instructional and guidance programs. Much of the present computer-assisted instruction is very poor, because teachers are not involved in designing and writing the text for software. The future will require a larger number of instructional designers. These master teachers and counselors will have tremendous influence, because their work will be utilized by a much broader audience than they would ever encounter in a traditional teaching setting.

Making Occupational and Educational Decisions

Although occupational choices are critical decisions, individuals often make them haphazardly. Adolescents and adults select occupations without an adequate knowledge of personal interests, skills, and values; without an awareness of the large number of available options; and without a systematic decision-making process.

There are a limited number of professional helpers to assist with the career decision-making process. The unsatisfactory ratios of counselors to students at both the secondary and college level, combined with the inadequate training of such personnel to deal with career development concerns, create a substantial need for improved and increased career decision-making assistance at the secondary and college level. The large percentage of adults making career transitions, combined with the dearth of guidance resources for adults, creates a need for additional ways to assist adults with the career choice and development process.

In the past ten years, the computer has become a very significant influence in the vocational choice process. Two major types of computer-based systems that assist individuals with vocational and educational choices have been developed in the United States (Harris 1972). One type, information systems, takes advantage of the capabilities of a computer to search large data files, identifies career options having the characteristics desired by the user, and displays information about each of these options. A second type, guidance systems, offers the same capabilities, but also provides experiences designed to help users learn about themselves (particularly interests, skills, abilities, and values) and relate these self variables to occupational alternatives. Guidance systems also may provide computer-assisted instruction about guidance topics (such as values, classification of occupations, or sources of financial aid) and may teach strategies for decision making.

Research on computer-based guidance and information systems collected over the past fifteen years indicates that the computer is a highly effective tool for assisting individuals with vocational and educational choices. Computer systems are effective because they have very high user appeal, they are objective, and they have the ability to handle massive data files, serve many users in different places simultaneously, and personalize user interactions based on stored user records and/or user input. Use of such systems can increase occupational knowledge (Rosenberg 1978; Willingham 1978); increase vocational maturity (Harris 1972; Smith and Gimmestad 1975); provide greater specificity of career plans (Wolff 1976); improve decision making (Chapman et al. 1977; Rosenberg 1978), and increase self-information. These desirable effects can be had for as low as two dollars per hour.

The convergence of three trends may make the computer one of the major influencers of vocational and educational decision making during the next decade, perhaps second in importance only to parents. The first and most important trend is the rapid growth of microtechnology. Today's relatively small, single-user transportable microcomputers costing about sixty-five hundred dollars have the power to deliver computer-based career guidance equal to that delivered by a large half-million dollar mainframe computer in 1966. Multiterminal microcomputer systems are already available with the capability to serve up to sixteen terminals simultaneously. One vendor's newly released machine has 256K of core storage, and hard-disc storage devices are now available for microcomputers with as many as thirty-three megabytes of external storage. The microcomputer revolution has arrived, and all predictions indicate that it will be as significant as the Industrial Revolution.

The second trend is the linkage of telephone, television, and computer technology to provide a plethora of services and opportunities in the home. The Bell Telephone System plans to make a service available to the American home in 1984 that will allow the ordering of groceries, the review of real estate options, the selection of a restaurant and menu for dinner, communication with friends, game playing with a distant player(s), and enrollment in a wide variety of courses. A system to assist the nation's youth and adults with their complex vocational and educational decision making will undoubtedly become a part of this technology.

A third trend is the availability, acceptance, and rapidly increasing acquisition of the personal computer for home use. The cost of these machines will continue to decrease while their capabilities will continue to increase. The IBM Corporation announced in August 1982 that it would be marketing a personal computer, a radical departure in two ways from its past history. The first noteworthy difference is the company's move toward small, single-user systems in place of the previous emphasis on large, multiuser systems. The second noteworthy difference is the marketing of its personal computer by vendors other than the IBM Corporation, including Sears. It is already possible, in some cities, for families to purchase a personal computer and a very wide assortment of computer-assisted instructional packages, games, career guidance modules, and home management aids, from home order catalogues, department stores, and discount houses as well as from more traditional sources.

All of these trends forecast that extensive educational and guidance services will be provided in the future by some combination of the home computer, the home television set, the telephone, and possibly the videodisc player. The computer and its associated devices will have a much greater influence on vocational choice, especially with the decision-making steps of identifying alternatives and collecting extensive information about these alternatives. Young people of the future will be aware of a much broader range of educational and vocational options, will be better able to relate educational experiences to work experience, and will be armed with more valid information with which to make appropriate career decisions. The increased availability of information should mean that adolescents can be more focused in their choice of vocational education and more systematic in planning their transition from school to work. Adults will be able to participate in lifelong learning with a higher level of specificity of goals. Since individuals' knowledge of both self-information and occupational information will be increased, less teacher and counselor support will be required, and the additional support that is needed will focus on higher-level career development processes.

Delivering Instruction

In the future, the computer will be used increasingly to support classroom instruction. This support will be provided in the classroom itself or in learning centers within the school or in the home. As microcomputers become more common, students may be assigned drill and practice or problem-solving types of experiences to be completed either in a specific place at school (for those who do not have a computer at home) or on the home computer using floppy discs loaned by the school. This trend will force teachers to analyze curricula and specify areas that can best be taught by humans and areas that can be taught as well or even better by computer. To make such judgments, teachers will need preservice or inservice training on the capabilities of computers and on the kinds of instructional processes that computers can most effectively perform.

A second major instructional change will be the setting in which instruction is delivered. Education can occur wherever a microprocessor can be housed. The home will become as important a learning setting in the future as the school building has been in the past. The microprocessor, the home TV set, and perhaps the videodisc player constitute the equipment for a new era of self-directed learning. Libraries and community centers will have equipment to serve the needs of those who do not have instructional equipment at home. It will be common in the future to check out floppy discs and videodiscs from the school or public library.

A final significant educational change in the future will be in the role of the teacher. Teachers will become program developers and learning managers. As more is understood about the learning styles of individuals and how to measure them, the computer can assist in the individualization of instruction. On-line instruments to assess learning styles may branch to alternate modes of computer delivery. For example, some students may have printed materials only; others may have a combination of written materials on the screen and audiovisual support from accompanying videodiscs. Blind students may receive braille printouts; deaf students may have special visual materials to aid their learning. Some students may receive the text and accompanying graphics at a very low reading and comprehension level. Similarly, tests may also be given on-line. Items may be randomly selected from a large item pool to create an individualized assessment and evaluation instrument for each student. The use of adaptive testing will allow high achieving students to spend less time in test taking. Branching routines designed to provide specialized instruction to individual students, based on their specific level of accomplishment and their special areas of content deficit, will provide the ultimate in personalized instruction.

These capabilities allow a shift in teacher role from information provider to manager and developer of instruction. The teacher of the future will enjoy the role of prescribing modes of instruction and of specifying those instructional activities most appropriate for each learner. The expertise of teachers will be needed to design interesting and creative curricula and to write the text, simulations, evaluation items, and feedback messages needed to support computer-assisted instruction. Quality instructional material with a variety of branching alternatives will be needed to meet individual learning styles and needs.

Summary

The ever-increasing pace of change in communications technology is exerting an important influence on the roles and training of adult, career, and vocational educators. Through creatively developed preservice and inservice training, teachers must be made aware of the fast pace of change and must be helped to feel psychologically comfortable with technology. The requirement for a strong combination of communications and technology skills will create a need for retraining teachers, and perhaps require revised criteria for teacher selection. Ways must be found to train for skills that have previously been viewed in the literature and research as dichotomous. Teachers of the future need to develop skills in selecting modes of instruction that will be effective with diverse students. They will also need to learn how to design, develop, and implement computer-based instruction. The new technologies will provide the capability for a much higher level of individualization of instruction than has been possible in the past, through diagnosis of learning styles and handicaps and the prescriptive branching available with computer technology.

The same factors that dictate these changes in teacher education will also create changes in the jobs to which future students will aspire. Career changes will be even more common. The microcomputer and its associated technologies will be a very significant helper in the career planning and implementation process as career guidance systems move into the home.

Finally, the most significant impact of communications technology may be that the lines between school, home, the work place, and the community will become less distinct. The home will become a significant learning place, as will the community through its libraries, shopping malls, and community learning and guidance centers.

A PHILOSOPHY TO GUIDE THE USE OF COMMUNICATIONS TECHNOLOGY IN VOCATIONAL EDUCATION

Katy Brown Greenwood
Texas A&M University

The need to understand the future has a fascination of its own. Any future projections are likely to create a significant interest because we want to know as much as possible about our future environment. Some writers have exploited our fascination with the future through such best sellers as *Future Shock* and *The Third Wave*, while the study of the future has become a major field commanding serious scholarship and academic respectability.

There are many converging forces of unprecedented significance that promise to alter the configurations of our future society, including the nature of work and the occupational structure. The search for signals about the future is all the more important because of the unsettled and unsettling events of our time. If anything is clear, it is that the future will not take care of itself. Nor will the future involve simply more of the same. The future will test to its very core the adaptive capacity of the United States economy, and the pivotal issue in that context will be the vocational flexibility and adaptability of its work force.

Specifying a Preferred Future

The study of the future can focus on several areas. First, there is an attempt to identify probable futures—that is, events that are most likely to occur in the future. Because they reside in the future, probable events are viewed as alternatives. This means that decisions and actions made in the present can influence events that might potentially occur in the future. A second major emphasis in the study of the future is on specifying preferred futures. The process of defining and influencing the future in preferred directions needs to begin with the clarification of values that will provide the basis for making decisions about the future. Within this context, how will vocational educators approach the study of the future? We must, indeed, study those alternative futures that have been suggested, and begin the task of reexamining the value and factual bases that will clarify characteristics of the preferred future.

This chapter also asserts that we can and should approach the study of the future philosophically. We must decide what "ought to be" in relation to technologies of the future. It is possible that the value premises that have served vocational education in the past and present will continue to be viable, but such values need revalidation. The ends or objectives that have led to present policies and practices in vocational education may also be viable, but also must be reexamined. Such a reexamination of the principles of vocational education can help develop a normative position for the future.

Developing a Normative Position for Vocational Education

In order to build a vocational philosophy for the future, William K. Frankena's model for analyzing educational philosophies is helpful (Frankena 1974). Frankena's model may be used either in an analytic manner (taking apart another person's philosophy) or in a normative sense (trying to put things together to create a rationale). Frankena's model offers a way of building a normative position that will consider the factual bases of a future society that relies heavily on information and communications technology. The model must be viewed in terms of Frankena's own concept of education:

> Education is primarily a process in which educators and educated interact, and such a process is called education if and only if it issues or is intended to issue in the formation, in the one being educated, of certain desired or desirable abilities, habits, dispositions, skills, character traits, beliefs, or bodies of knowledge (if it is intended to but does not, it is called bad education), for example, the habit of reflective thinking, conscientiousness, the ability to dance, or a knowledge of astronomy. (Frankena 1974, p. 140)

For the sake of convenience, Frankena refers to all such educational outcome states as dispositions and concludes that education is the process of forming or trying to form such dispositions. According to Frankena, a complete normative philosophy of education will accomplish three specific tasks:

1. The main task of a normative philosophy of education is to list and define a set of dispositions to be fostered by parents, teachers and schools (and by the pupil himself). That is, it must say what dispositions are desirable and ought to be cultivated.

2. It will give a line of thought to show that the dispositions listed by it are desirable or should be cultivated.

3. It will tell us what we should do in order to acquire or foster the dispositions recommended by it. (p. 141)

The schematic representation of these tasks is diagrammed in figure 1, along with the substantive elements of Frankena's model and their relationships.

The main task of listing and defining a set of dispositions to be fostered is illustrated in Box C of figure 1; however, the line of thought that indicates why the dispositions are desirable is indicated in Box A (norms) and Box B (factual premises), and the line of discourse that specifies what should be done or how to acquire or foster the dispositions recommended in Box C is indicated in Box D (empirical evidence) and Box E (recommendations). When all five boxes are filled in, Boxes A, C, and E will be comprised of value statements. Boxes B and D will contain factual premises and empirical evidence. This theory suggests that it is not possible to go directly from scientific understanding or technological advancement to policy and practice. Practice is always a combination of norms (Box A) and factual premises (Box B).

The final task of a normative philosopher will include normative statements, supported by empirical evidence that is discovered by observation and experiment or borrowed from psychology and other disciplines (Box D), to show that the methods and measures advocated are necessary, helpful, or effective in the formation of the dispositions in Box C. In other words, utilizing the Frankena model, the full-fledged normative philosophy of vocational education will have two parts. One part is represented by the A-B-C pattern and provides reasons *why* such dispositions should be fostered; the other part is characterized by the C-D-E pattern, which recommends *how* such dispositions should be fostered.

In order to keep future scenarios and future projections within a balanced framework between both values and facts, the Frankena model can help place the descriptions of the future within a philosophic context that includes value premises that do not change with time. Without such a structural framework, technological change becomes overpowering. Given the balance of normative development, humanity (or the individual) can remain at the center of the universe—the common hope of both a liberal and a technical/vocational education. Thus, technologies, as such, must continue to be examined from the perspective of how they benefit humanity, not vice versa.

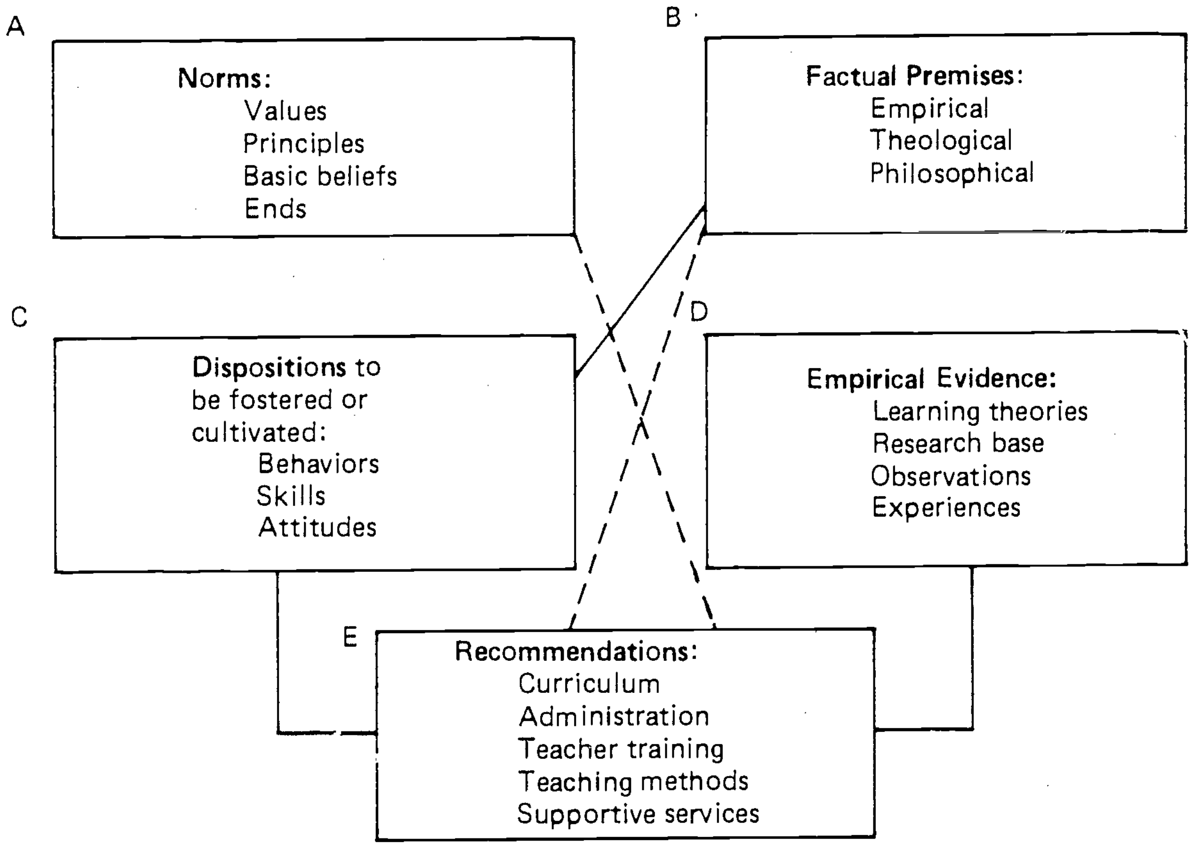

Figure 1. Model for analyzing educational philosophies

Vocational Education's Historic Philosophy

Prior to the first federal legislation for vocational education in 1917 (the Smith-Hughes Act), early vocational education leaders put together the skeleton parts of a vocational education rationale. Figure 2 represents Greenwood's interpretation of the philosophy that was developed by Charles A. Prosser, foremost early leader of vocational education, and endorsed by the National Society for the Promotion of Industrial Education (NSPIE), the first professional group of vocational educators, in 1916 (Greenwood 1978, p. 274). These interpretations of the historic philosophy of vocational education can provide a basis for comparison of the value and factual premises of the future.

A. NORMS

Basic Values:

- Democracy
- Utility
- High standard of living
- Minimal industrial and social unrest
- Complete living
- Life adjustment

B. FACTUAL PREMISES

Economic theory:

Vocational education will conserve and develop natural resources, prevent waste of human labor, provide a supplement to apprenticeship, increase wage-earning power, meet the increasing demand for trained workmen, offset the increased cost of living, enhance national prosperity.

Social and educational theory:

Vocational education will democratize the country by recognizing different tastes and abilities and giving equal opportunity to all to prepare for their life work and by extending education through part-time and evening instruction. It will give a positive effect to the aims and methods of general education, introduce into the curriculum the aim of utility, and develop a better teaching process for children who do not respond to book learning, who need to learn by doing. It will decrease industrial and social unrest due to lack of vocational training, and it will promise a better education that will result in higher standards of living for individuals.

C. DISPOSITIONS

Ability to pursue life work

E. RECOMMENDATIONS

Life experiences should be provided before age of 14 to give better information for choosing life work.

Testing and training should be given to uncover tastes and aptitudes.

Attempts should be made to assist toward appropriate career avenues.

Mere manual training should be avoided.

Teachers should show general experience and equipment of suitable character.

Different tastes and abilities should be recognized.

Equal opportunity should be given.

Education should be extended through part-time and evening instruction.

D. EMPIRICAL EVIDENCE

Manual training does not prepare for life work.

Figure 2. Prosser's philosophy of vocational education—1916

Essentially, the "why" components of the philosophy established "vocational competence" as a disposition to be fostered by the public schools. This disposition was arrived at after empirical evidence was given to indicate that at the age of fourteen, young people normally made a choice: to go on to school or to begin a work life. Thus, the case was made that formal preparation was needed for youth (as well as adults) to function within an industrial society, and that the federal government should, in providing for the general welfare of the nation in partnership with the state, fund education-for-work programs at no cost to these potential workers. Other economic, social, and educational theories were integrated as part of the rationale to support the notion.

Policy implementation features (Box E) recommended that the administrative structure be separate from the regular school program, and the teacher of the vocational student be trained differently than the regular teacher. The belief was that the vocational teacher should be, first and foremost, a trained artisan with experience on the job for which he or she was preparing potential workers. Manual training, industrial arts, or other practical arts that gave only a cultural emphasis without imparting saleable skills were rejected as part of the vocational curriculum. These concepts have remained fairly constant within the field of vocational education until the present time.

Constructing a Philosophy of Vocational Education for the Future

In examining the value and factual bases for the future, we are struck by trend lines that may confront us with the "hinge effect" noted by Amitai Etzioni (1977). By this, Etzioni is suggesting that the future may be so different that trend lines rooted in the past may "tilt, corner or break," so that we have a nonlinear relationship—a disconnected or at least different future. The rate of change in the future may be somewhat different than in the past. A synthesis of futurists' predictions seems to indicate an expectation of changes in at least five categories that will affect the planning and delivery of vocational education. These changing dimensions will occur in (1) the work force, (2) the nature of clients to be served by vocational education, (3) the needs of employers, (4) educational practice, and (5) governance role and structure.

Philosophically, critical questions for vocational education will include those that will determine whether the changes will remain viable, or whether the changes will involve only the practical aspects—the policy implementation features of the system. Within the five categories mentioned previously, the magnitude of change occurring will require continuous assessment to see what influence they might have in modifying the vocational education philosophy for the future. Some of the possible value and factual premises that are likely to be noticeable in the future are included in the following list.

A. NORMS

1. The Work Force

a. Increased desire of population to define selves in terms of marketable skills
b. Increased desire for "paid" employment
c. Increased belief in the right to work and the right to fair levels of pay
d. Belief in diversity as an explicit value
e. Growing resistance to traditional authority
f. Growing expectations of quality leisure-time experiences, such as travel and vacationing
g. Growth of physical, cultural, and personal health expectations
h. Growing expectation for individual choice about work environment, output rates, and alternative incentives

i. Growing insistence that jobs be less depersonalized
j. Growing preference for cooperation rather than competition on the job

2. Needs of Employers

a. More willingness to deinstitutionalize work and to utilize short-term contracts and diverse approaches to productivity
b. Increased personalization of the employer-employee relationship
c. View of the human worker as an economic unit—to be replaced with mechanical worker if more cost-efficient

3. Clients for Vocational Education

a. Older workers may want retraining and new careers at retirement age
b. Women, handicapped, and immigrant populations will expect and demand equal pay for equal work
c. An increasing acceptance of domestic job sharing and occupational job sharing
d. Less motivation by duty and more motivation by personal gratification
e. Duty to oneself—not to employers or others
f. Expectations of collegial rather than hierarchical arrangements at work
g. Expectations of well-defined productivity measures, evaluation methods, and reward systems

4. Education

a. Educators will begin to value credentials more than degrees
b. "Turf" attitudes by educators will of necessity be decreased; cooperative agreements with alternative and diverse school settings will be made
c. New competencies will be expected of administrators to work with the new technologies
d. New competencies utilizing the technologies of the future will be expected of teachers

5. Government

a. Belief in less government involvement in education and vocational education
b. Lack of commitment to establishing work and education-for-work policies at the federal level
c. Belief in greater private sector involvement in job training programs

B. FACTUAL PREMISES (FUTURE TRENDS)

1. The Work Force

a. Increased specialization
b. Growth of the service sector
c. Growth of information industries, movement toward an information society
d. New technological impact:
   — Telematics (combination of telecommunications, computational, and information technology)
   — energy and production of materials
   — new genetics (molecular-biological developments)
e. Increased conservation and sharing of resources

f. Physical changes in work place due to telematics technology
g. Decline of traditional work ethic
h. Expansion of credentialism
i. More diverse work population with various responses to incentives
j. Career pattern diversity—midlife changes and early retirement

2. Needs of Employers

a. Increasing diversity in work site: home, mobile units, decentralized work places
b. Decreasing ties on part of corporations to communities—but increasing geographic mobility
c. Increased need for explicit levels of competencies of workers
d. Increased expectations regarding worker productivity
e. Increased propensity to train workers on the job
f. Increased use of telematics—expanding network of telecommunications and computer usage
g. Increased reliance on mass media in telecommunications and printing
h. Increased need for research and development
i. Integration of the national with the international economy
j. Increased search for curbing costs of labor
k. Growth of multinational corporations

3. Clients for Vocational Education

a. The trend toward an older median age will continue
b. A larger proportion of the populations needing vocational education will be older than in previous times
c. The trend toward women entering, staying, and expecting advancement in occupations will continue
d. Fewer children born to working women
e. Shifts in rates of family formation, marriage, divorce, and living styles
f. Replacement of extended family by the nuclear family and other living arrangements
g. Isolation of children from adults
h. Isolation of aging population from other populations
i. Growth in do-it-yourself projects
j. Increasing demands from the handicapped for independence through paid work
k. Increasing immigrant populations from Latin America, Africa, the Mideast, and Southeast Asia

4. Education

a. Trend toward utilization of educational technology will continue
b. New levels of quality, effectiveness, and cost efficiency are being found for educational technology
c. Key telematic technologies will remake educational practice, including hand calculators, computers, videodiscs, morpheme generators, voice compressors, video portapacks, cable television, satellite broadcasting
d. New partnerships in providing a learning environment will be formed among schools, businesses, the home, and community organizations
e. Mass education will be possible for all populations through technology
f. Specialized education will be more feasible for all populations through technology
g. Continuing lifelong education will be more accessible through technology

h. Flexible scheduling will be necessary
i. Mobile units and shared resources will be more efficient
j. There will be less federal involvement in schools and the need for more national consolidation and standard setting
k. A greater range of information about the working world will be available to students through technology

5. Government

a. Less federal resources for vocational education
b. Increased emphasis on state responsibility for vocational education
c. Increased emphasis on linkage with private sector and coordination among public agencies in the work preparation area
d. Less standard setting by federal agencies
e. Less attention to civil rights
f. More attention to stimulating economic productivity

C. DISPOSITIONS

1. Dispositions to Be Fostered by Vocational Education

a. Ability to interpret vocational skills to employers in terms of measured competencies
b. Ability to utilize various forms of information
c. Habits of seeking additional information about areas related to work
d. Knowledge and skill in using telematic devices advantageous to the work area
e. Attitudes of conservation and efficiency regarding worklife
f. Ability to negotiate alternative work environment and incentive patterns
g. Ability to plan ahead and foresee shifts in employment picture
h. Acceptance of continuing lifelong learning as important
i. Ability to communicate work needs in terms of total personal fulfillment
j. Ability to cooperate at the work site in terms of greater productivity and harmony
k. Ability to share and negotiate domestic job duties so that home and work preferences can be harmonized
l. Skills at decision making in considering conflicts between valued preferences and factual conditions
m. Income-producing skills
n. Income-saving skills—practical knowledge of home repair and consumer saving
o. Knowledge about the full range of occupations and training needed to obtain jobs

In reviewing the potential changes to the historic philosophy of vocational education, it seems unlikely that any of the expected changes of the future indicated in the list will alter the basic historic premises, except in the category of governance structure. The projected alterations in the work force, the needs of employers, and the nature of clients for vocational education, are all changes that will affect the policy implementation features of vocational education, but not the basic rationale. However, the trend that has been visible, in the current and recent Congresses, of phasing out the federal involvement in any kind of educational program would drastically change the fundamental assumptions of the field of vocational education. One of the most strongly felt premises held by vocational educators is that job training should be sponsored by a partnership of local, state, and federal funds. The federal role has been central to prescribing the standards and practices that have made the field of vocational education "national" in its delivery. A person in the northeastern part of the country, or on the West Coast, has essentially the same kind of vocational training in a comparative sense as the person in the South or Southwest. The common practices among states have been assured by federal involvement.

It is possible that new communications technologies can help replace a loss of national solidarity brought about by the demise of federal funds. Communications linked with information systems could, through networking, replace the rules and regulations of federal law by providing the information needed to nationalize the system. Through network linkages and central clearinghouses, such technology could possibly assist a professional association, such as the American Vocational Association, or local professionals in providing a common base of information to ensure that potential workers trained in the South, for example, can function as well in other parts of the nation or vice versa, and that they are all afforded access to the most up-to-date training resources.

The dispositions part of a future philosophy will be somewhat different from the dispositions of the past. The concept of "vocational competence" will be much broader and encompass different tasks that traditionally have been excluded as specific to vocational education. In the past, blind loyalties to the employer and an unquestioned acceptance of the work environment were seen as desirable worker traits. However, in the future, objectivity, evaluative and innovative skills, and an understanding of long-term planning on the part of employees will be seen as desirable, in addition to the essential competencies to perform the job itself. In order to survive the rapid shifts in the labor market, individuals must be able to assess the likelihood of their jobs being discontinued and should feel free to discuss openly such matters with their employers, without antagonism on either side.

Coming full circle from the historic period, practical arts that provide income-saving skills, rather than income production, will be in the forefront again. If jobs are not in abundance in the future, income-saving and survival skills will become as valuable as income-producing skills.

Modifying the Policy and Practice Features of a Vocational Education Philosophy

In constructing policy features for the future (Box E), little empirical evidence (Box D) can be relied on to recommend the best methods of a delivery system, but speculations can be made. A competency-based individualized curriculum will be essential, linked to all the available communications devices and media forms that will make the instruction interesting, learnable, efficient, and effective. Research on these best methods will certainly be needed. Career guidance counselors will be able to rely on sophisticated information systems to portray the world of work to their clients. These systems will also enable the counselor to have ready access to individual student information essential for providing optimal guidance services. Telematic devices will also be available for students to interact with demonstration work sites or with other groups that will provide information they need.

Computerized management information systems will also be used much more extensively in the planning and development of vocational education programs; larger amounts of data will be used more efficiently for sound decision making. One of the continuous criticisms of vocational education has been its inability to keep up with rapid change in the work place; information systems will help to alleviate this problem. In addition, more accurate and usable follow-up data will be available via computerized systems, which will decrease the gap between the occupational training provided and the needs of the labor market itself.

Vocational teacher training itself can become more standardized with telecommunication networking and use of televised programming. Inservice training could be provided nationally, rather than locally, which would have the potential of building a better knowledge base in vocational education. Communications technology could conceivably create a national network for vocational education that could provide a consolidating mechanism formerly provided by federal legislation.

The information data bases and communications technology that will be available in the future can be a major resource for vocational education. The specification of data on skill needs at the shop or plant level can be immediately transmitted to corporate headquarters and serve as an intelligence network to be fed into systems that deal with the recruitment and deployment of human resources. For the first time in our industrial history, vocational education will not be obligated to build its superstructures on the somewhat uncertain foundations of the occupational needs of that outside society. As the detail about complexity and refinement is recorded for each production unit, we can emerge with a wealth of information that will guide the education and training process to satisfy those needs. We will be able to shift from a modified form of "flying by the seat of our pants" to scientifically guided use of our educational resources, based on hard evidence rather than intuition. More than anything else, this future reality, created by information and communications systems, will support the need for investment in vocational education.

REFERENCES

Abbott, W. "Beating Unemployment Through Inflation." *The Futurist* (August 1978): 215-221.

"Able to Soar While Cable Hovers." *CableVision* (Supplement) (July 5, 1982): 5-10.

Beane, J.; Amante, A.; Cavanagh, R.; Hammond, G.; Maxson, J.; Sherman, R.; Stephen, W.; and Tubbs, M. *An Introduction to Educational Futures*. St. Bonaventure, NY: St. Bonaventure University, 1979. (ERIC Document Reproduction Service No. ED 189 700).

Bell, D. *The Coming of Post-Industrial Society: A Venture in Social Forecasting*. New York, NY: Basic Books, 1973.

Chapman, W.; Katz, M. R.; Norris, L.; and Pears, L. *Field Test and Evaluation of a Computer-based System of Interactive Guidance and Information*. Princeton, NJ: Educational Testing Service, 1977.

Coates, J. *A Mini-Assessment: Environmental Consequences of Developing Communications Technologies*. Washington, DC: J. F. Coates Inc., 1981.

"Communications Satellites: The Birds Are in Full Flight." *Broadcasting* (November 19, 1979): 37-47.

Conant, T. "An Overview of Technology Assessment and the American Workplace." In *Technology Assessment and Occupational Education in the Future*. Proceedings of a conference sponsored by the U.S. Department of Education. Washington, DC: Government Printing Office, 1979. (ERIC Document Reproduction Service No. ED 204 605).

Cooper, B., ed. *ITFS—Instructional Television Fixed Service (2500 Megahertz), What It Is. . .How to Plan*. Washington, DC: National Education Association, 1967. (ERIC Document Reproduction Service No. ED 018 980).

Dede, C. "Educational, Social, and Ethical Implications of Technological Innovation." *Programmed Learning and Educational Technology* (November 1981): 204-213.

Dede, C. "Educational Technology: The Next Ten Years." *Instructional Innovator* (March 1980): 17-23. (ERIC No. EJ 219 900).

Denison, E. "Explanations of Declining Productivity Growth." *Survey of Current Business* (August 1979): 1-23.

Donnelly, W. J. *The Emerging Video Environment*. New York, NY: Young and Rubicam, 1977.

Drucker, P. F. "As Education Heads into a 'Baby Bust,' Competition and Diversity Will Prevail." *The Chronicle of Higher Education* 22 (May 4, 1981): 56.

Etzioni, A. "Opting Out: The Waning of the Work Ethic." *Psychology Today* (July 1977): 18.

Evans, C. *The Micro Millenium*. New York, NY: Pocket, 1979.

"FCC Opens Skies to DBS." *Broadcasting* (June 28, 1982): 27-28.

Feldman, M. "Looking Ahead: A Matter of Necessity." In *The Future of Vocational Education* (1981 Yearbook), edited by G. Swanson. Arlington, VA: American Vocational Association, 1981. (ERIC Document Reproduction Service No. ED 204 604).

Frankena, W. F. "A Model for Analyzing A Philosophy of Education." In *Selected Readings in the Philosophy of Education*. 4th ed., edited by J. Park. New York, NY: Macmillan, 1974.

Fraser, B. *The Structure of Adult Learning, Education, and Training Opportunity in the United States*. Worker Education and Training Policies Project. Washington, DC: National Institute of Work and Learning, 1980. (ERIC Document Reproduction Service No. ED 200 723).

Goldstein, H. *Training and Education by Industry*. Worker Education and Training Policies Project. Washington, DC: National Institute for Work and Learning, 1980. (ERIC Document Reproduction Service No. ED 200 721).

Grant, W. V., and Eiden, L. J. *Digest of Education Statistics*, 1980. Washington, DC: National Center for Education Statistics, 1980. (ERIC Document Reproduction Service No. ED 202 085).

Greenwood, K. "A Philosophic Rationale for Vocational Education: Contributions of Charles A. Prosser and His Contemporaries from 1900 to 1917." Volumes I and II. Ph.D. dissertation, University of Minnesota, 1978.

Handel, S. *The Electronic Revolution*. Harmondsworth, Middlesex, England: Penguin Books, 1967.

Harris, J. A. "Analysis of the Effects of a Computer-based Vocational Information System on Selected Aspects of Vocational Planning." Unpublished doctoral dissertation, Northern Illinois University, 1972.

Holland, J. L. *Making Vocational Choices*. Englewood Cliffs, NJ: Prentice-Hall, 1973.

Hutchins, R. M. *The Learning Society*. New York, NY: Praeger, 1968.

Institute for the Future. *Policy Choices in Vocational Education*. Menlo Park, CA: Institute for the Future, 1979. (ERIC Document Reproduction Service No. ED 189 370).

Joseph, E. C. "Long-term Electronic Technology Trends: Forecasted Impacts on Education." Paper presented to the Congress of the United States, House of Representatives, Committee on Education and Labor, Subcommittee on Elementary, Secondary, and Vocational Education, 1979. (ERIC Document Reproduction Service No. 179 878).

Kay, A. *A Dynamic Medium for Creative Thought: The Dynabook*. Palo Alto, CA: Xerox Palo Alto Research Center, 1973.

Levin, H. *Economic Democracy, Education, and Social Change*. Program Report No. 79-B16. Stanford, CA: Stanford University, Institute for Research on Educational Finance and Governance, June 1979. (ERIC Document Reproduction Service No. ED 176 369).

Lewis, M. V., and Russell, J. F. *Trends, Events, and Issues Likely to Influence Vocational Education in the 1980s*. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1980. (ERIC Document Reproduction Service No. ED 195 825).

Licklider, J. *Social and Economic Impacts of Information Technology in Education*. Cambridge, MA: Massachusetts Institute of Technology, Laboratory for Computer Science, 1979.

Lipson, J. "Riding the Wave of the New Information Technologies: The Administrator's Role." Paper presented at EDUCOM Conference, Kansas City, Missouri, October 1981.

McLuhan, M. *Understanding Media: The Extensions of Man*. New York, NY: McGraw-Hill, 1964.

Miernyk, W. "The Dynamics of the Eighties." In *1979 Fall Leadership Conference for State Directors of Vocational Education. Charting a Course of Excellence for Vocational Education in the 1980s*, compiled by M. Newton and S. Cox. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1979. (ERIC Document Reproduction Service No. ED 204 595).

Molnar, A. "Understanding How to Use Machines to Work Smarter in an Information Society." *Technological Horizons in Education* 7 (January 1980): 42-46. (ERIC No. EJ 228 659).

Newcomb, P. L. *Some Influences on Teachers and Teaching in 2030: Projections, Predictions, and a Scenario*. Paper presented at the Annual Meeting of the Speech Communication Association, 1979. (ERIC Document Reproduction Service No. 179 878).

Norman, C. *Microelectronics at Work: Productivity and Jobs in the World Economy*. Worldwatch Paper 39. Washington, DC: Worldwatch Institute, 1980. (ERIC Document Reproduction Service No. ED 192 144).

O'Toole, J., Brousseau, K.; and Ralston, A. *Employee Entitlements in the Eighties*. Report F-38. Los Angeles, CA: University of Southern California, Center for Futures Research, 1979.

Porat, M. "The Information Economy." Ph.D. dissertation, Stanford University, Institute for Communication Research, 1976.

Rosenberg, H. G. *Career Information Plus Counseling Pays Off*. Number One in the series: Research and Practice in Career Development and Career Education. Boulder, CO: University of Colorado, 1978.

Ruff, R., and Shylo, B. "The 1980s: A Window in Time." In *The Future of Vocational Education* (1981 Yearbook), edited by G. Swanson. Arlington, VA: American Vocational Association, 1981. (ERIC Document Reproduction Service No. 204 604).

Ruff, R.; Shylo, B.; and Russell, J. F. *Vocational Education: A Look into the Future*. Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1981. (ERIC Document Reproduction Service No. ED 201 792).

Sloan Commission on Cable Communications. *On the Cable*. New York, NY: McGraw-Hill, 1971.

Smith, M. L., and Gimmestad, B. "Evaluation of Project CVIS." Unpublished report. Boulder, CO: Bureau of Educational Field Services, School of Education, University of Colorado, 1975.

Stakenas, R., and Kaufman, R. *Educational Technology and Cost Reduction in Higher Education: Five Alternative Futures*. Tallahassee, FL: Florida State University, 1977. (ERIC Document Reproduction Service No. ED 169 923).

"Teletext and Videotext." *Broadcasting* (June 28, 1982): 37-49.

Theobald, R. "Creating a Desirable Educational System." Presented to the Congress of the United States, House of Representatives, Committee on Education and Labor, Subcommittee on Elementary, Secondary, and Vocational Education, 1979. (ERIC Document Reproduction Service No. 179 878).

Tough, A. "Major Learning Efforts: Recent Research and Future Directions." *Adult Education* 28 (Summer 1978): 250-263. (ERIC No. EJ 197 451).

U.S. Congress, Office of Technology Assessment. *Computer-Based National Information Systems: Technology and Public Policy Issues*. Washington, DC: Government Printing Office, 1981.

"Video Disc Update: McGraw-Hill's 'The Development of Living Things'." *Videoplay Report* (July 24, 1978): 2-3.

Video Source Book. 3rd ed. Syosset, NY: National Video Clearinghouse, 1981.

Willingham, A. *Evaluation of SIGI Program, 1978*. Report available from author at Mercer County Community College, 1200 Old Trenton Road, Trenton, New Jersey 08690.

Wise, K.; Chen, K.; and Yokely, R. *Microcomputers: A Technology Forecast and Assessment to the Year 2000*. New York, NY: Wiley, 1980.

Wolff, W. W. *Evaluation of the Colorado Career Information System, 1976*. Report available from COCIS, Willard Hall, University of Colorado, Boulder, Colorado 80309.