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ABSTRACT

Part of the Department of Education's planning and review process on the potential role and application of learning and electronic technologies in education, this report is based on a review of information from several sources, including reports, studies, survey data, and other literature on the availability and use of electronic technology in elementary and secondary schools and institutions of higher education; previous technology programs funded by the Department of Education; selected efforts and experiences of other Federal agencies that have applied electronic technology to education and training; and current activities and future plans of private sector companies. On the basis of this review, it was concluded that: (1) there is evidence that electronic technology can be used to improve the quality of education for American students; (2) there is a growing need for our schools to prepare Americans to use technology in their personal and work lives; and (3) there is a great deal of eagerness among school officials to employ the new electronic technologies to improve the quality of education and to familiarize students with the uses of technology. Six major recommendations are included in the report, and 44 references are listed. (LLS)

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REPORT
of the
U.S. DEPARTMENT OF EDUCATION
TASK FORCE

on

LEARNING AND ELECTRONIC TECHNOLOGY

JANUARY 1981

This report is an element in the Department's planning and review process on the potential role and application of learning and electronic technologies in education. The conclusions, recommendations and other content are those of the task force and do not necessarily represent the policy of the Department. Some of the information contained here may be of use to school systems and others interested in this subject.

To the Reader:

We are in the midst of a microelectronics revolution which is having profound influence on education. Modern electronic information technologies -- microprocessors, computers, video recording devices, and inexpensive means of storing and transmitting information -- are creating a revolution and are changing the world as we know it. This revolution is making profound changes in the way business and industry is conducted and in the nature of many jobs.

This information revolution will not change one of the most important functions of education, e.g., teaching the students the basics of reading and writing. It will only make such knowledge even more essential than ever before. Despite billions of dollars each year poured into education, there are an estimated twenty-five million Americans who are functionally illiterate, individuals who cannot read a want ad or a bus schedule or a label on a medicine bottle. Another thirty-four million have a bare capacity to perform simple reading tasks. A continuation of this problem has dire consequences for the United States in economic productivity and consequently for national security. A literate and thinking citizenry is needed to confront the challenges of the modern world.

While it is important to teach students how to read, it is important also to teach them what to do with these words after they read them - interpret, draw conclusions, reason, use imagination, create images, evaluate and criticize. These skills will be even more necessary as the information revolution progresses and the individual is faced with sophisticated cable and computer technology both at work and at leisure. The cry of alarm of the 1950's, "Why Johnny Can't Read", could well become in the 1980's, "Why Johnny Can't Log On." We need to recognize technology as an important new instrument for learning the basics in education. While it took many years after the development of television to use it for educational purposes, there is now the opportunity to use the new technology for education simultaneously with its development. It is not a surrender to technology, but merely the wisdom to recognize and utilize its benefits.

It is interesting to note that summer camps for students between ten and eighteen years old are being conducted to teach electronic games and computer language. These computer camps are responding to the need to make students computer-literate. Computer technology cannot be effectively utilized unless school officials, teachers, and students know how to use it effectively in the classroom.

The new world being created makes new demands on education. Workers will need greater knowledge of science and mathematics, and greater skills for the orderly thinking that underlies much of human performance at work and in the conduct of human affairs. Fortunately, the new information technology creates not only new educational needs, but also new ways of meeting these needs in school at relatively low cost. There are forces at work in the market place which are unrelated to educational applications. These will ensure declining prices for

hardware. This is in sharp contrast to rising costs in education and other labor-intensive sectors of the economy. Schools with proper planning and programs can utilize these changes to the benefit of their students, even in these times of fiscal restraint.

Schools and school publishers are already beginning to explore this new opportunity for improving teaching and learning in the classroom. A recent sample survey of schools reveals that by the end of last year, there were about 21,000 computer terminals and another 31,000 microcomputers available for student use. The 31,000 microcomputers alone represent an expenditure of about $45 million, all of it in the last two years.

In July of 1981, the Office of Educational Research and Improvement sponsored an invitational meeting which brought together officials of the U.S. Department of Education and the private sector and opened a dialogue on the use and developments of electronic information technologies for learning. Secretary of Education T.H. Bell gave the keynote address for this very useful conference, which provided a forum for the exchange of views on the state of the art.

From the exchange of views at the conference mentioned above, there appeared certain obstacles and concerns -- an uncertain school market (in contrast to the more definite business market for information technologies) and memories of heavy losses in the market for educational technology in the 1960s. These two factors stand as barriers to inhibit large investments by the private sector in the field of educational technology.

Although these persistent memories may slow the growth in investment, real conditions are much changed and must inevitably influence the behaviors of the schools, interested elements of the private sector, and agencies of the Federal Government, including especially the Education Department. For example:

- Hardware is now electronic, more reliable and less costly, with video screen, color and sound, and small and quiet enough to deploy and use in the classroom.

- The emphasis now is on student use of the system and on learning by individualization. Experience gained in fifteen years of trial-and-error in the development and exploratory use of educational computer software has produced examples of software that, while primitive in its structure, content, and presentation, reveals a significant capacity for keeping the learner actively engaged for sustained periods; allow instruction to be adjusted to the rate and style appropriate to the individual learner; and provide the learner with a variety of previously unattainable experiences and problem situations through modeling and simulation.

- During a period of revenue decline, schools are faced with a problem for which the use of educational technology appears to be the only way to provide students with a better education while labor costs continue to rise.

The Education Department is also now engaged in a reexamination and redefinition of its role to one that is catalytic and facilitative, conducting activities that would be wasteful if carried out independently in each of the States. Research on effectiveness, development of knowledge and techniques necessary to reveal the full educational potential of the new technology, and dissemination of this information in a timely way to the State and local level where decisions on education practice are made are clearly included among these activities. New federal programs or massive federal expenditures which could dictate form and content for schools are neither necessary, nor wanted, nor needed.

This staff review of earlier departmental activities in educational technology is a preliminary step to the development of new policy and planning in this area. The conclusions and recommendations do not necessarily represent the policy of the Department. This document is released for public use to open a dialog with interested school practitioners and elements of the private sector on the critical issues affecting the development and use of modern information technology to improve teaching and learning in the schools, and on the role and activities of the Department in assisting to realize this goal. If it requires the reader to think more extensively and more deeply on the significance, meaning and many uses of technology for educational improvement, this report will have served its purpose.

Donald J. Senese
Assistant Secretary
Educational Research and Improvement

EXECUTIVE SUMMARY

The Task Force on Learning and Electronic Technology has prepared this report based on a review of information from several sources.

Specifically, the Task Force reviewed:

- Reports, studies, survey data, and other literature on the availability and uses of electronic technology in elementary and secondary schools and institutions of higher education.
- Previous technology programs funded by the Department of Education and its antecedent agency, the Office of Education.
- Selected efforts and experiences of other Federal agencies that applied electronic technology to education and training.
- Current activities and future plans of private-sector companies.

Based on this review the following conclusions have been reached:

- There is evidence that electronic technology can be used to improve the quality of education for American students.
- There is a growing need for our schools to prepare Americans to use technology in their personal and work lives.
- There is a great deal of eagerness among school officials to employ the new electronic technologies to improve the quality of education and to familiarize students with the uses of technology.
- The Federal Government's research and development efforts have played an important role in applying new technologies for educational uses.
- Many private sector companies have made tentative forays into developing technological products and services for education. The outlook for future efforts to expand the impact is not bright, largely because education systems provide few significant incentives to private-sector entrepreneurship in this area.
- The potential benefits of technology in education will not be fully realized unless the Federal government, including the Department of Education, plays an active, effective leadership role to achieve that goal. Experience with such diverse projects as "Sesame Street," the development of closed captioning of TV for the deaf, and research and development on new videodisc technology convincingly demonstrate that the Federal government

can play a very important role without trespassing on the rights and responsibilities of State and local governments or of the private sector.

This report lists the significant barriers blocking the full realization of the potential benefit of the new technologies, and then makes several specific recommendations for overcoming those barriers. Implicit in the recommendations is the notion that a strong leadership role is required in this matter. The task force suggests that the Secretary of the Department of Education can fulfill this role--through his own personal leadership and through the direction he gives to the Department--and thereby help all segments of the American public realize the enormous potential of the new technologies and the necessity for immediately beginning to harness them for educational uses.

The major recommendations of the the task force to that end are that:

- o Through news conferences, speeches, and other information-disseminating devices, the Secretary of Education should help make the general public, professional educators, and lawmakers aware of the potential educational benefits of the new technologies and of the need for students to be educated about and with these technologies so that they may understand and control them, for their own purposes and for the good of our society.

- o The Secretary of Education should call together chief state should officers and major school district superintendents for the purposes of sharing with them his view of the benefits of technology to the improvement of quality education and the importance and need for technical literacy in our society.

- o The Department should establish a "partnership" with state and local education officers, private sector companies, and universities. This partnership should lead to the development of mechanisms through which state and local education agencies could work with private-sector companies to plan and implement technology in their curricula.

- o The Department should provide incentives to encourage private-sector/university combined efforts to develop exemplary "high quality" software for computers and videodiscs. This should be done in cooperation with school districts and state education agencies that elect to participate in such ventures. The purpose is to get all involved in making the trade-offs that will be needed to successfully implement the new technologies in instructional settings.

- o The Department should take primary responsibility for identifying specific examples of any Federal Government barriers to success and coordinate efforts to resolve these problems.

- The Secretary should, through his office, coordinate the activities of other Federal agencies in educational and training uses of technology so that joint efforts among these agencies can be facilitated.

The task force hopes that its efforts will further the development within the Department of a consensus about the problem and its solution.

I. THE PROBLEM

The rapid adoption of technology to improve American productivity and enhance the personal and business lives of our citizens is well underway in many areas except formal education. In fact, Americans do not realize that many of the materials and methods used in their educational systems are on the verge of obsolescence or that we are producing students whose limited knowledge of science and technology hinder instead of help private-sector and government efforts to maintain our leadership position among nations of the world. American students are not being given the opportunity to keep up with the technological developments that will play an increasingly vital role in their lives.

Two major problems exist regarding the use of technology in our educational systems. The first is that formal education systems are not making full use of electronic information technologies to improve the quality of instruction. The second is that schools are not preparing American students to use technology itself.

According to the 1980 National Science Foundation and Department of Education report to the President, Science and Engineering Education for the 1980's and Beyond, most students are not receiving adequate education and training in science, mathematics, and technical literacy. The report states that over the past fifteen years there has been a steady erosion of "our national commitment to excellence and international primacy in science, mathematics, and technology."

We, as a nation, may be losing our competitive edge over other industrialized countries -- principally Japan, Germany, and the Soviet Union. Some even think we are no longer the "number one" industrialized power. Japan has already eclipsed the United States as the foremost industrialized society according to Ezra Vogel, Harvard University professor and author of the book, Japan as Number One. The Japanese, states Vogel, clearly dominate the radio, tape-recorder and stereo-system-equipment market areas. Just this year, Japan became the world's leading producer of automobiles and is now making progress in catching the U.S. in steel production and electronic technology. Japan's prominence can be traced, in part, to its education program, which produces superior students in science and mathematics. As Vogel points out, in the 1970 international science test given to 10 to 14 year olds in 19 countries, Japanese youth -- for both age groups -- ranked first overall. In grand-total score, America ranked 15th out of the 19 countries.

There have been many previous reports warning our nation of this problem. For example, 11 years ago in 1970, the report of the Commission on Instructional Technology stated the problem directly:

> "a society hurtling into the age of computer and the satellite can no longer be held back by an educational system which is limping along at the blackboard-and-textbook stage of communication."

And the 1980 report to the President from the National Science Foundation and the Department of Education makes it clear that the problem is getting worse:

> "Today, people in a wide range of nonscientific and nonengineering occupations and professions must have a greater understanding of technology than at any time in our history. Yet our educational system does not provide such understanding."

Continued failure by schools to utilize, in a comprehensive and systematic manner, the broad range of existing and emerging electronic technologies will hinder efforts to improve the quality of education in general, as well as frustrate efforts to improve our nation's productivity rate. This can have a significant effort in weakening our nation's prosperity and security.

II. TECHNOLOGY IN EDUCATION

How can technology be used in a school system to improve the learning process? Below are some descriptions of ways in which a few technological devices have been adapted for use in schools:

For Students

Computers can help students learn to read more effectively by providing drill in word recognition and pronunciation through the use of voice simulation. Improvement in quality results because the computer can provide more practice exercises than a student would normally receive.

Computers make it possible to study the behavior of objects such as satellites, electrons, and biological and chemical systems through simulation. This allows for new dimensions of learning not possible through other techniques.

Videodiscs give students access to a large number of pictures and information that would not normally be easily available to them. Such discs make it possible to explore subjects in greater depth in the classroom than has heretofore been possible.

Videodiscs in combination with computers not only can provide access to a tremendous volume of information but, in fact, guide students to explore areas that may be unfamiliar to them. These machines make it possible for many students to improve and expand their knowledge base in almost any subject area.

Two-way cable TV makes possible virtually instantaneous interaction between geographically separated teachers and students. This capability makes it feasible for larger numbers of students to learn from the leading authorities teaching on college campuses.

Word processors and automated dictionaries can immediately identify for students misspelled words, grammatically incorrect sentences, and/or punctuation problems. Such immediate feedback can help students find and correct errors without having to wait until a classroom teacher can collect, grade, and return a writing assignment. As a result of such practice and feedback, the acquisition of skill and cohesion in writing can be gained at an early stage of the student's educational experience.

Calculators and hand-held learning devices can provide students with sophisticated tools for learning, including drill and practice in basic skills.

For the deaf person, technology makes it possible to understand the audio track of television programming through captioning. As a result, the deaf can benefit from educational television.

For the gifted student, computers and videodiscs can provide newer and more numerous challenges. As a result, we can create educational experiences that may not otherwise be possible in many small school systems.

For Teachers

As instructional tools, computers, videodiscs and integrated electronic systems extend the range and power of instructional techniques and strategies. For example, computer-generated graphics can be utilized by the teacher to depict processes or concepts in ways not previously possible.

Optical scanners and computers can assist in the grading of routine student assignments. As a result, teachers will have more time to concentrate on teaching the subject matter and reviewing the student's progress in mastering the subject.

Similarly, computers can help teachers more quickly diagnose student's learning difficulties. As a result, a teaching strategy to help the student can be arrived at early in the school year.

Through the use of cable television, videodiscs, and computers, teachers can take courses at home to upgrade their skills or knowledge of their subject matter.

For Administrators

Computer-based record keeping systems can help relieve many administrative burdens. Thus, principals and other school officials would be free to manage the teaching/learning process better.

Standardized testing can be improved through the use of large computerized banks of test items. Such tests could provide both educators and parents more complete information about a student's performance.

Using improved audio, video, and computer-conferencing techniques, administrators can manage more efficiently, and save money on increasingly large travel bills.

III. BARRIERS BLOCKING FULL REALIZATION OF THE POTENTIAL

There is increasing interest among professional educators and private business people in helping school systems throughout the country realize the various benefits offered by educational uses of the new technologies. Some state and local school systems have begun limited use of some of the new equipment, and many school systems have been using television successfully for several years.

However, indications are that it is not just a matter of time until all, or even many, school systems are using the new technologies to their fullest and best advantage. There are significant barriers standing between the development of the technology and its productive implementation in formal education. The causes and effects of and the solutions to these barriers frequently overlap, but for clarity and purposes of discussion, the major barriers have been separated here into three main categories: educational, private-sector, and governmental.

A. EDUCATIONAL SYSTEM BARRIERS

1. The need for public understanding and funding: In our democratic system, the schools reflect primarily the needs and values of the state and local communities they serve. All citizens of these communities, not just professional educators, must therefore become informed about the new technologies and their potential benefits if the technology is to be fully utilized in schools. Implementation of the new technologies will require shifting the use of limited funds, and this funding must come from citizens who are aware of the need for widespread technological literacy and hands-on competency. Most Americans are not yet aware of the needs and potential educational benefits of the new technologies.

2. The organization of public school systems: School systems, and in some cases individual schools within a system, are quite independent of each other. This is highly desirable in many ways; however, as a result of this, it is often difficult to coordinate various decisions that must be coordinated if many of the technologies are to be used to their best advantage. For example, sharing of data bases may be impossible if each local school system within a state decides to purchase a different brand of computer.

3. The purchasing process in most school systems: In most public school systems, the purchasing process requires decisions and approval from several levels of the organization. This can often result in long delays for a purchase decision. Most technological companies deal with markets in which decisions are made much more quickly. Such companies find the educational market to be too different from the markets they are experienced

in serving, and thus they are reluctant to develop products for schools.

4. The lack of objective information and experience: Technological hardware is changing rapidly, and educators have few effective ways of keeping up with the changes and their implications for learning. School administrators, teachers, and parents lack objective sources of information about the new technologies, and they are frequently untrained in purchasing technological devices or in evaluating claims of efficacy. Few state, local or private mechanisms offer much help.

5. The lack of qualified personnel: In most school systems, as in private industry, there is a severe shortage of people qualified to use and teach about the new technologies. As of yet, teachers have little formal incentive to learn about or to use the new educational technologies. And in a time of shrinking budgets and declining enrollments, many teachers are suspicious that the technology will undermine their authority or replace them.

6. Past patterns of spending by schools: "...schools are used to a pattern of big spending on people and buildings and austere economy on everything else. Educational institutions must change their economic philosophy if they are going to take advantage of information technology effectively and efficiently." (J.C.R. Licklider, "Social and Economic Impacts of Information Technology on Education.")

7. Previous uses of computers by schools: "The main thrust of computers applications in education has been to use the computer to push facts into students. The approach that works best... is to use the computer and auxiliary technology to create a stimulating learning environment and to make the computer a partner to the student in exploring and in solving problems." (Licklider)

8. The need for more work on educational applications of technology

"Information technology provides the essential raw materials for revolutionary advances in education, but they are raw materials. They have to be processed into educational technology. At the present time, few educators understand information technology, and few information technologists understand education....It is going to take a very large amount of software development, oriented toward education and carried out by groups that understand both education and information technology, to create the essential base of educational technology. In educational television, it has been clear for a long time that 'programming' is as important as cameras, transmitters, and receivers -- and very costly. In computer-based educational applications, there will have to be an analogous appreciation of the importance of 'programming' and 'application software.'" (Licklider)

B. PRIVATE-SECTOR BARRIERS

1. Lack of familiarity with the school market: Private companies that are producing technological hardware think of schools as a secondary market, at best. Consequently, little effort is made to develop and market new equipment for formal educational uses. Even for their home markets, where potential educational uses are often mentioned in descriptions of technologies such as videodiscs and computers, these companies are developing and marketing entertainment more aggressively and effectively than education.

2. Lack of qualified personnel: The development of effective educational programs, even for home use, requires experience and skills different from those needed to develop entertainment programs. There is little evidence that major companies will soon acquire or be able to train the personnel necessary for designing new educational technologies.

3. Inadequate capitalization in segments of the industry: The companies which currently have the greatest potential for creating educational software to be used with the technological hardware are the textbook publishers. Most of these companies are relatively small and probably cannot afford the sizeable investments necessary to develop the most useful types of software for the school markets.

4. Incompatible hardware: Many of the machines that can be used for educational purposes are not compatible with each other. For example, there are a bewildering number of different types of videotape recorders; videodisc players, microcomputers, and computer language dialects. Manufacturers, to date, have shown almost no interest in making their machines compatible. Unlike the consumer market, the most cost-efficient and effective use of technological hardware in school systems will require machines that can be used in conjunction with each other.

C. GOVERNMENT BARRIERS

1. At the Federal level: Lack of coordination is a major problem. For example, there is no single Federal agency responsible for educational telecommunications policy. Consequently, many government agencies, such as the Federal Communications Commission, and the National Telecommunications and Information Administration in the Department of Commerce make policy affecting technology--all with little realization of its educational implications.

The Department of Education, the Department of Defense, The National Aeronautics and Space Administration, and the National Science Foundation are all actively engaged in funding research and development of educational technology. Because the efforts of these "educational technology" research and development agencies are not well coordinated with the efforts of the "telecommunications policy-making" agencies, confusion and conflicting activities sometimes occur. Two examples are illustrative:

a. While Congress and the Department of Education were changing rules to facilitate school use of the Instructional-TV fixed services (a part of the TV spectrum allocated to educational usage), the Federal Communications Commission was proposing rules to re-allocate that part of the spectrum to other uses.

b. Because of the rules on standards of sponsorship of the Public Broadcasting Service, which receives most of its funding from the Federal Government educational TV programs funded by the Federal government have sometimes been ineligible to run on public TV.

2. At the state and local levels: Lack of information is a major problem. Only a small handful of state and local governments have recognized the potential of the new education technologies and taken steps to provide leadership for their educators and school systems. Until they can become informed on these matters, the state legislatures and the executive constitute barriers to acceptance, funding, and use of the new technologies for education. It should be noted that there are important exceptions to this situation in Pennsylvania, Minnesota, Nebraska, Florida, California, and Oregon.

IV. RECOMMENDATIONS FOR OVERCOMING THE BARRIERS

As the causes and effects of the barriers frequently overlap, so to — it is hoped -- will the effects of the following suggestions for action to get over, around, or through the barriers. The Task Force recommends that the Secretary of Education direct that the following steps be taken to deal with each barrier.

A. EDUCATIONAL SYSTEM BARRIERS

1. The need for public understanding and funding.

Recommendations:

- o Through news conferences, speeches, and other information-disseminating devices, the Secretary should help make the general public, professional educators, and lawmakers aware of the potential educational benefits of the new technologies and of the need for students to be educated about and with these technologies so that they may understand and control them, for their own purposes and for the good of our society.

- o The Department of Education should conduct meetings, seminars, and research projects specifically designed to provide expert information for public dissemination. The results of such meetings, seminars, and research could be sent by the Secretary to state and local education agencies for their information. In addition, the Secretary could publicize this information through television appearances, press conferences, and broadly distributed printed reports.

- o The Department should support a long-term in-depth study of the impact of information technology on child growth and development, with special emphasis placed upon the impact of television on linguistic development, reading, and general information.

- o The Department should — through its own use of technology in the day-to-day conduct of its relations with school systems, higher education institutions, and educational researchers — foster understanding of the benefits of instructional technologies. Such activities as the following could accomplish this task:

  — Institution of a regular dialogue between the Secretary and the principal operating personnel and chief state school officers through PBS satellite feeds.

— Teleconferencing to monitor both state programs and specific grants and contracts.

— Telemail to transmit relevant documents between regional offices, state education agencies, and contractors and granteees.

— Utilization of video recorded materials and teleconference resources for major presentations.

— Establishment of incoming Federal Telecommunication System lines for the purposes of sharing information. These could take the form of audio-information, computer-information, data-transfer, and referencing systems.

o The Department should support and publicize the development of projects of sufficient size, scope, and duration to have a national impact on education. "Sesame Street" is one example of a long-term project of a size and scope sufficient enough to have an effect upon a generation of preschoolers and to make the public aware of the educational capabilities of television.

2. The organization of public school systems.

Recommendations:

o The Department of Education should encourage chief state school officers to assign a person in each state to coordinate solutions to problems associated with the application and use of instructional technology in that state

o The Department should encourage states to consider innovative non-restrictive ways of setting statewide standards for technical hardware and software that is to be used in schools.

3. The purchasing process in most school systems.

Recommendations:

- The Secretary of Education should encourage states to consider setting up buying cooperatives for school districts so that the market for technology in schools can be more easily understood by manufacturers and software producers.

4. The lack of objective information and experience.

Recommendations:

- The Secretary of Education should share with chief state school officers and major school district superintendents his view of the benefits of technology to the improvement of quality education and the importance and need for technical literacy in our society.

- The Department should use information technologies to communicate information about technology to school administrators.

- The Department should fund demonstrations of the use of promising technology in education, and then broadly promote the results of those demonstrations.

5. Past patterns of spending by schools.

Recommendations:

- The Department should take steps to ensure that some attention is paid to hardware development especially suited to schools. For example, if a teacher could select 200 words of his or her own choice to go into a Speak and Spell, and then easily insert them (e.g., via a chip) into each student's loaned (school-owned) device, the acceptance by teachers may be much greater than with factory-selected lists/chips.

- The Department should regularly survey the use (or non-use) of technology in schools: calculators, microprocessors (or personal computers), television, video machines, etc. The National Center for Education Statistics/Corporation for Public Broadcasting study on television utilization is a good example, as is the present "fast response survey" of use of computers in schools. A commitment should be made to continue such studies for at least five years--perhaps a different technology every year. Statistics from sources other than ED should also be collected.

6. The need for more work on educational application of technology

Recommendations:

- o The Department should offer to work in partnership with State and local education officers, private sector companies, and universities to help foster the development of new curricula that take advantage of the new technologies. Such activities should include but not be limited to the following:
  - — Stimulate the development of a consortium of agencies that defines its needs and funds jointly the development of courseware for new technologies.
  - — Stimulate the development of consortia of institutions of higher education and private companies who work with education agencies to develop in-depth courseware and services in the creation of new technological applications to education.
- o The Department should encourage and support experimentation with interactive television modes. Such activities shall include but not be limited to the following:
  - — Development of supplemental materials which can provide for the transmission of computer programs to accompany the television programs.
  - — Development of radio and other audio systems that can reach specific demographic groups to meet their educational needs.
- o The Department should use existing program authorities and funds to encourage the technical development of instruction technologies through contracts issued to private-sector vendors.
- o The Department should encourage private-sector/university combined efforts to develop exemplary "high quality" software for computers and videodiscs. This should be done in cooperation with school districts and state education agencies that elect to participate in such ventures. The purpose is to get all involved in making the trade-offs that will be needed to successfully implement the new technologies in instruction settings.

B PRIVATE SECTOR BARRIERS

1. Lack of familiarity with the school market.

Recommendations:

- o As previously suggested, the Department should ask states to consider setting up buying cooperatives for school districts so that the market for technology in schools can be easily understood by manufacturers and software producers.

2. Lack of qualified personnel.

Recommendations:

- o As previously suggested, the Department should use existing research funds to encourage private-sector/university combined efforts to develop exemplary computer software. This should be done in cooperation with school districts and state education agencies that elect to participate in such ventures. This activity would result in a larger pool of qualified people.

3. Inadequate capitalization in segments of the industry.

Recommendations:

- o The Department should use existing program authorities and funds to encourage the technical development of instructional technologies through contracts issued to private sector vendors.

4. Incompatible hardware.

Recommendations:

- o The Department should suggest that states consider finding innovative non-restrictive ways of setting standards for technological hardware and software.

C. GOVERNMENTAL BARRIERS

1. At the Federal level: (Lack of coordination).

Recommendations:

- o The Department should take primary responsibility for finding specific examples of Federal Government barriers to success and convene all agencies for the purpose of resolving these problems.

- o The Secretary should, through his office, coordinate the activities of other Federal agencies in educational and training uses of technology so that joint efforts among these agencies can be facilitated.

- o The Department should remove all management barriers and regulations which inhibit the use of technology in delivering services to children and teachers. Such activities shall include but not be limited to the following:

— Remove regulations that restrict the uses of technology such as automatic data processing equipment for the purposes of instruction. Establish separate policy and guidelines for the use of such equipment in educational modes as opposed to management data systems.

-- Remove the restrictions on the production of audio-visual materials.

o The Department should continue what was begun this year: collection of an annual inventory of projects involving technology and education.

2. At the State and local levels: (Lack of the information).

Recommendation:

o The Department should become the conduit for sharing information on technology development and applications of technology to education.

APPENDIX A

The Historical Role of the U.S. Department of Education In Applying Electronic Technology to Education

Among the Federal agencies, the former Department of Health, Education, and Welfare (HEW), and now the Department of Education (ED), have played a significant role in the research, development, and demonstration of educational improvements through the use of electronic technology. Other Federal agencies with important roles in the past include the Federal Communications Commission, the National Science Foundation, and the Department of Defense. The relatively new National Telecommunications and Information Administration, in the Department of Commerce, is also an important agency in this field.

A chronological overview of major landmarks in the use of technology by HEW and ED to improve education is presented below:

1958 — Public Law 85-905 authorizes establishment of a loan service of captioned motion pictures for the deaf; this is later expanded to include education, and all media. The program is the nucleus which later becomes the Bureau of Education for the Handicapped (BEH).

1962 — Congress establishes the Education Broadcast Facilities Program, which makes its first grant the following year. Through 1978, when the program was moved to the Department of Commerce, $151 million in grants were made, vastly improving the capacity of public radio and television stations across the nation.

Mid - 1960s — By this time HEW's Office of Education (OE) had supported three major instructional television libraries: the Northeastern Regional Educational Television Library; the Great Plains Instructional Television Library; and the National Instructional Television Center (now the Agency for Instructional Television).

1966 — OE begins support of ERIC, the Educational Resources Information Center. This information system uses print materials, microfiche, and computerized data bases to provide access to pertinent documents in various fields of education. ERIC was moved to the National Institute of Education (NIE) in 1972. The data base now consists of more than 400,000 units, and over more than 135,000 searches are performed annually. Funding for all activities, 1967-1980: $60.5 million.

1968 The Office of Eduation supports the Children's Television Workshop (CTW) to begin work on Sesame Street. Funding of CTW for The Electric Company begins in 1972. By the end of fiscal year 1981, ED funding for both these programs will be completely phased out. Total funding, 1968-1981, is $48.3 million. The number of viewers per day is about 15 million for Sesame Street and about 6 million for The Electric Company

1970 HEW establishes an Office of Telecommunications Policy.

1970 The Office of Education funds the Dallas Independent School District to develop "Simu-School," a set of computer programs for district-wide planning based on models of enrollment, teacher load, and costs. Simu-School is later disseminated through the National Diffusion Network and used in dozens of school districts. This is a rare example of HEW/ED discretionary funding for administrative application of technology in elementary secondary education.

1970 - 1971 Beginning of intensive work to develop closed captioning of television for the deaf. Through 1980, Bureau of Education for the Handicapped spends about $10 million on this project.

1971 The Bureau of Education for the Handicapped begins funding the Optacon. During the development phase (1971-1976) about $2.5 million is invested. During the dissemination phase (1976-1980) about $4 million is spent, which includes purchase of more than 1200 Optacons.

As part of the American delegation to the World Administrative Radio Conference (WARC), HEW plays a key role in establishing an international reservation of Instructional Television Fixed Service (ITFS) frequencies for satellite communications (i.e., certain TV channels), for education and for other purposes.

1972 Congress passes the Emergency School Aid Act (ESAA) as part of the Education Amendments of 1972. The development of innovative interracial educational television and radio programs is authorized as part of ESAA. Through 1980 a total of 29 programs are produced at a cost of $67 million, including Villa Alegre, Vegetable Soup, and Infinity Factory.

1973 For the first time, the educational television funds are used for programs other than Sesame Street and The Electric Company Series include Footsteps; 3-2-1 Contact; Music Is; Powerhouse, and others. The Critical Television Viewing Skill project is funded beginning in 1978. Through 1981 funding for projects other than Sesame Street and The Electric Company totals about $20 million.

1974 BEH begins funding NIMIS (National Instructional Materials Information System) to provide special education staff with a computerized data-base on instructional materials for the handicapped. Later, funding for this project went to NICSEM (National Information Center for Special Education Materials). Total for both: about $8.5 million.

1974 Health/Education Telecommunications (HET) experiments begin using NASA's Applications Technology Satellite 6 (ATS-6). Areas involved are the Rocky Mountain States, Appalachia, and Alaska. Departmental funding through 1976 totals about $20 million.

1975 BEH begins funding the Kurzweil reading machine for the blind. About $800,000 is invested in research and development, and approximately $3 million more to purchase 95 machines.

1976 NIE begins funding a five-year evaluation by the Educational Testing Service (ETS) of the use of computer assisted instructions in the Los Angeles public schools. Results are due in late 1981. Funding, 1976-1981: $2.5 million.

Public Law 94-309 establishes the Telecommunications Demonstration Program in HEW to promote the development of non-broadcast telecommunications facilities and services (e.g., cable TV, microwave, satellite, telephone) for education and other social services. Expenditures, 1977-1980: $3 million.

1977 Following evaluation of the ATS-6 demonstration, the Department begins funding implementation of operational telecommunications systems for education, and other social services, in both Alaska and Appalachia. Total funding, 1977-1980: about $9.4 million.

First captioned films and media services grant competition. Includes all media, a large proportion of which are electronic based, including videotape and microcomputers. Funding 1977-1980: about $12 million.

1978 National distribution of Freestyle begins, a children's television series to promote career awareness and to combat stereotyped thinking about male/female career roles. NIE funds development and evaluation at a cost of $4.2 million.

The Education Amendments of 1978 authorize a $2 million set-aside to apply technology to problems of instruction in the basic skills. Monies first available in FY 1980.

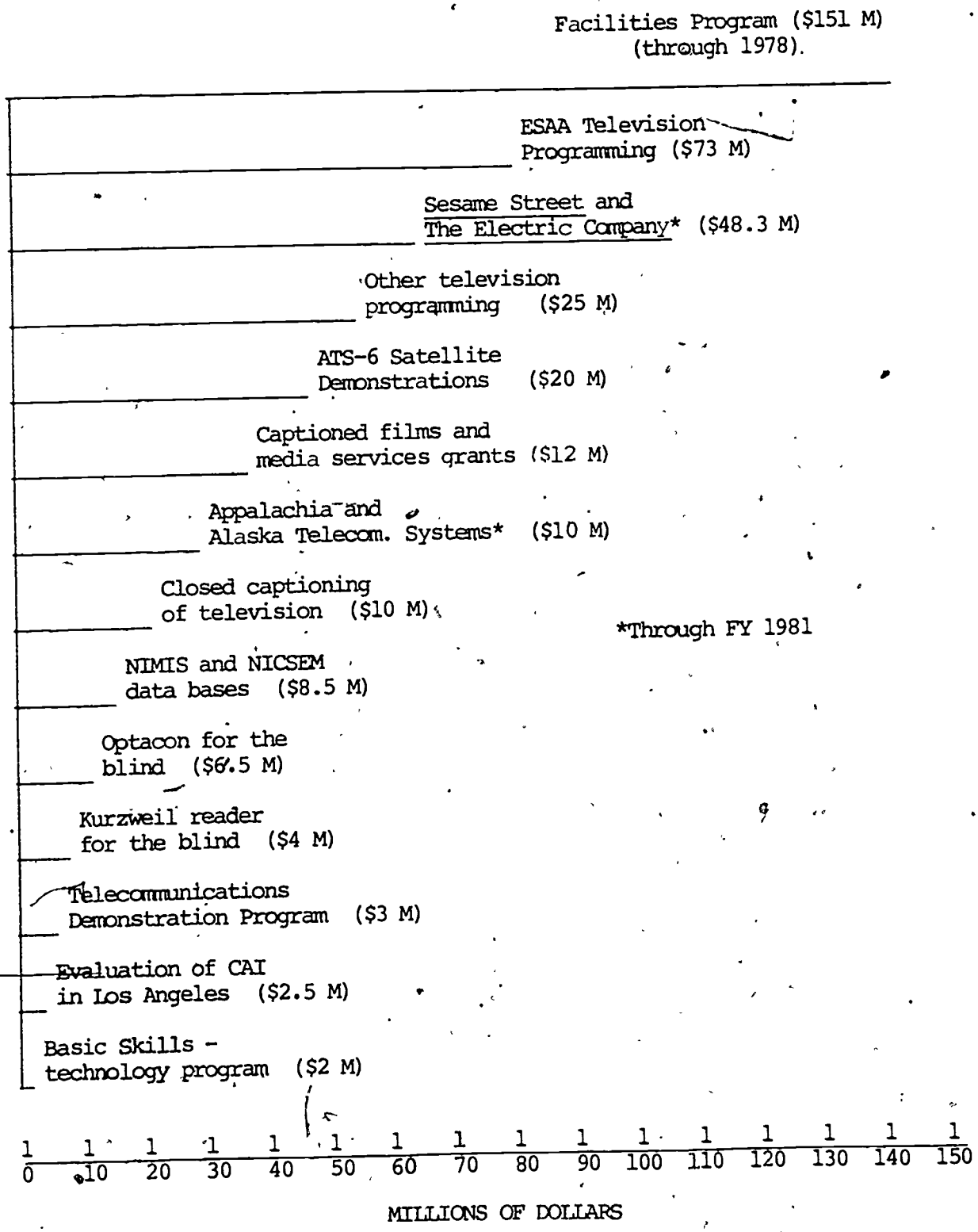
1979 In march HEW announces the voluntary agreement for closed captioning of television among ABC, NBC, PBS, Sears, the National Captioning Institute, and HEW.

1980 First competition takes place in the joint NIE-NSF program Improving Mathematics Education Through Information Technology.

In March the first television caption decoders are marketed by Sears. Sales in 1980 are about 32,000 units.

APPENDIX B

Major HEW/ED Expenditures
To Improve Education Using Electronic Technology
(Through Fiscal Year 1980)



APPENDIX C

Technology Projects Funded by ED - Fiscal Year 1980

During Fiscal Year 1980, the Education Department funded an estimated $47 million in electronic technology projects. Listed below are four categories of electronic technology along with the estimated amount of funding provided for each category. Within these categories are examples of some of the projects that have been supported. A detailed list of all projects funded in Fiscal Year 1980 is available in the Inventory prepared by the Task Force.

o Telecommunication	$19,470,800
o Computers, calculators, and video discs	21,593,200
o Video tapes	1,007,800
o Other (planetariums, language laboratories)	4,914,700

COMPUTERS, CALCULATORS AND VIDEO DISCS

Examples in this section fall under three headings:

1. Computers
   - Main frame
   - Mini computers
   - Micro computers (personal computers)
2. Calculators
3. Videodiscs

Computers

The support for computers has been quite varied. Five examples illustrate the variation:

- o Courseware development in mathematics for elementary, high school, and college courses is underway in four projects.
- o MIT is developing an interactive computer model for providing information to the general public.
- o Researchers at the University of California, Santa Barbara, are studying the process by which students learn computer languages so that future students can be taught computer languages more effectively.
- o Xavier University is training its mathematics faculty to teach introductory courses in computer science.

- o Community School District 18 in Brooklyn is developing an administrative/management support system for the district.

Calculators

- o Two studies of the uses of calculators in the curriculum are underway.
- o CEMREL, Inc. is developing a mathematics curriculum for grades K-6 which will include the use of calculators for instruction.

Videodiscs

- o A project at Brigham Young University is developing videodiscs for use in the teaching of Spanish.
- o A project at the National Audio-Visual Center will transfer TV programs to the videodisc format.

TELECOMMUNICATIONS SYSTEM

Some examples of projects supported are shown below;

Radio: Eight projects were granted funds to produce and broadcast radio shows. One project, Options in Education, has been exploring education issues for five years. In another project, a museum is sponsoring an art appreciation show; five projects will promote interracial understanding; and one project will help teenagers and their parents understand adolescence.

Television: Twenty six projects were granted funds to produce and broadcast TV shows. Four projects are developing pilots for series to make people aware of the contributions that racial and ethnic minorities have made to our country. Also funded were two career programs, two minority contribution series, a series to help teenagers and parents understand adolescence, an art appreciation series, a women's sports series, and a health and nutrition series for fourth to sixth graders. An additional thirteen projects were funded to broadcast college courses, teacher training courses, and shows of interest to the general public.

Satellites: Three satellite projects were funded to develop courses to be broadcast by satellite. They are:

- o Educational Telecommunication for Alaska
- o Appalachian Community Services Network
- o Education Broadcasting Corporation

Telephone Systems: Four universities were granted funds.

The University of Wisconsin is developing an automated, dial-access telephone-information system which will be used to increase its capacity for delivering informational messages to the general public on such subjects as health care, continuing medical education, home gardening, nutrition, and food preparation.

The University of Michigan is delivering classroom-type instruction to people through telephone computer facilities.

The University of Cincinnati is providing doctors, pharmacists, and other health professionals in two rural hospitals, one suburban hospital, and one urban hospital with the opportunity to request specific medical information from a major medical center by using a slow-scan TV and telephone system.

Eastern Montana College is upgrading its conference system, which provides instruction to inhabitants in sparsely populated areas. The grant will allow the university to permanently link together thirty learning sites throughout the state.

Telecommunication for the Deaf

In addition to captioning, four projects received funds to develop communication systems for the deaf. The Center for Excellence is providing information for the handicapped and homebound by using FM-radio Subsidiary Communication Authority receivers to drive teletypes for the hearing-impaired, and Braille teletypes for those who are both deaf and blind. The Roman Catholic Archdiocese of Boston is demonstrating and evaluating the use of a computer-aided telecommunications system to allow deaf people to communicate with both other deaf people and hearing people. This system uses an existing operative language -- HERMES; it allows a message to be sent or received by deaf persons using a computer terminal coupled to a telephone.

Two projects are using electronic mail to deliver information to the deaf -- SRI International is designing a national network and Boston University is implementing interactive computerized language instruction.

Assessment of Educational Use of Broadcast Mediums

Two projects were funded to investigate the use of telecommunications to meet education and public service needs. The Corporation for Public Broadcasting is assessing how television can be used for effective education. New York University's Alternate Media Center is analyzing social and public needs for information services which can be provided via broadcast teletext.

Closed-Circuit Television

Two closed-circuit television projects were funded in Fiscal Year 1980. The Cook County, Illinois, Department of Corrections is studying methods for teaching mathematics to prison inmates by comparing four delivery systems: a teacher right on the prison tier, a teacher in the Pace Institute classroom away from the tier, broadband closed-circuit television, and slow scan television and audio equipment connected by the telephone.

Teaching Machines

The Department supported the development of several teaching machines for the handicapped.

- Telesensory Systems, Inc., Palo Alto, California, is producing a portable reading machine for the blind which integrates an optical character recognition system and a synthesized speech system.

- The University of Illinois is developing for the blind a talking microcomputer terminal with two language capabilities.

- With Department funds the University of Michigan is training teachers to use the optacon reading machine with blind students.

APPENDIX D

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