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Report and Recommendations

SELECT COMMITTEE ON PUBLIC EDUCATION
Senate Concurrent Resolution 22

CHANGING TECHNOLOGY IN INSTRUCTION

WILLIAM P. HOBBY, CHAIRMAN
LIEUTENANT GOVERNOR OF TEXAS

BILL CLAYTON, VICE CHAIRMAN
SPEAKER OF THE HOUSE OF REPRESENTATIVES

REP. WILLIAM BLANTON, CHAIRMAN
SUBCOMMITTEE ON CHANGING TECHNOLOGY IN INSTRUCTION

Submitted to the Sixty-Eighth Legislature
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The State of Texas
Sixty-Seventh Legislature
First Called Session

SENATE CONCURRENT RESOLUTION 22

Establishing the Select Committee on Public Education to study and make recommendations of methods to provide quality public education.

WHEREAS, High quality education for the citizens of Texas is a vital public concern, and a major portion of the state's total budget is appropriated for education; and

WHEREAS, The education system will be undergoing important changes as a result of recent major policy decisions in such areas as curriculum reform, bilingual education, and requirements relating to teacher competency; and

WHEREAS, Additional decisions may need to be made, particularly concerning financial matters, following the outcome of current litigation and the proposed reduction in federal funds and considering the growth of the permanent school fund; and

WHEREAS, Local independent school districts need to reevaluate their current programs in light of the statewide assessment results, and many districts face continuing difficulty in financing capital expenditures; and

WHEREAS, The legislature indicated its continuing concern and need for additional information about education matters during the Regular Session of the 67th Legislature by authorizing interim studies of educational costs and of vocational education; and

WHEREAS, These important and widespread changes, along with continuing general property tax concerns, create a need for leadership and for a forum for cooperation and communication relating to public education in Texas; now, therefore, be it

RESOLVED by the Senate of the State of Texas, the House of Representatives concurring, that the 67th Legislature, 1st Called Session, hereby establish a special committee to study the issues and concerns relating to public education in Texas, including curriculum reform, bilingual education, requirements relating to teacher competency, and alternative methods of financing; and, be it further

RESOLVED, That the committee be composed of 18 members, including the lieutenant governor, chairman; the speaker of the house of representatives, vice-chairman; the chairman of the Senate Committee on Education; four other members of the senate, to be appointed by the lieutenant governor; the chairman of the House Committee on Public Education; four other members of the house, to be appointed by the speaker of the house; the chairman of the State Board of Education; two other members of the State Board of Education, to be appointed by the chairman of that board; the chairman of the Governor's Advisory Committee on Public Education; and two other members of the Governor's Advisory Committee on Public Education, to be appointed by the governor; the chairman shall appoint advisory committees, as necessary, and the committee shall hold meetings and public hearings at the call of the chairman; and, be it further

RESOLVED, That the Central Education Agency be authorized to provide an executive director and staff support for the committee to assist with the conduct of the study; and, be it further

RESOLVED, That the committee have the power to issue process to witnesses at any place in the State of Texas, to compel the attendance of such witnesses, and to compel the production of all books, records, documents, and instruments that the committee may require; if necessary to obtain compliance with subpoenas and other process, the committee shall have the power to issue writs of attachment; all process issued by the committee may be addressed to and served by any peace officer of the State of Texas or any of its political subdivisions; the chairman shall issue, in the name of the committee, such subpoenas and other process as the committee may direct; in the event that the chairman is absent, the vice-chairman or any designee of the chairman is authorized to issue subpoenas or any other process in the same manner as the chairman; witnesses attending proceedings of the committee under process shall be allowed the same mileage and per diem as are allowed witnesses before any grand jury in the state. The testimony given at any hearing conducted pursuant to this resolution shall be given under oath subject to the penalties of perjury; and, be it further

RESOLVED, That the committee be authorized to request the assistance, where needed in the discharge of its duties, of all state agencies, departments, and offices, and that it be the duty of such agencies, departments, and offices to assist the committee when requested to do so; the committee shall have the power to inspect the records, documents, and files of every agency, department, and office of the state, to the extent necessary to the discharge of its duties within the area of its jurisdiction; and be it further

RESOLVED, That the operating expenses of the committee be paid from the Contingent Expense Fund of the Senate and the Contingent Expense Fund of the House, equally, and that the committee members be reimbursed from these funds for their actual expenses incurred in carrying out the provisions of this resolution; and, be it further

RESOLVED, That the committee make complete reports, including findings, recommendations, and drafts of any legislation deemed necessary, to the legislature as necessary and appropriate; copies of the reports shall be filed in the Legislative Reference Library, with the Texas Legislative Council, with the Secretary of the Senate, and with the Chief Clerk of the House.

ATTEST:

WILLIAM P. CLEMENTS, JR.
Governor of Texas

WILLIAM P. HOBBY
Lieutenant Governor of Texas

BILL CLAYTON
Speaker of the House of Representatives

BETTY KING
Secretary of the Senate

BETTY MURRAY
Chief Clerk of the House

Date Passed: August 10, 1981

Select Committee On Public Education

Chairman
The Honorable William P. Hobby
Lieutenant Governor of Texas
Houston, Texas

Vice Chairman
The Honorable Bill Clayton
Speaker of the House of Representatives
Spring Lake, Texas

The Honorable W.E. (Pete) Snelson
State Senate
Chairman, Senate Education Committee
Midland, Texas

The Honorable Ray Farabee
State Senate
Chairman, Senate Affairs Committee
Wichita Falls, Texas

The Honorable Grant Jones
State Senate
Chairman, Senate Finance Committee
Abilene, Texas

The Honorable Oscar Mauzy
State Senate
Chairman, Senate Jurisprudence Committee
Dallas, Texas

The Honorable Mike Richards
State Senate
Vice Chairman, Senate Subcommittee on Elections
Houston, Texas

The Honorable Hamp Atkinson
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The Honorable Bill Blanton
House of Representatives
Vice Chairman, House Public Education Committee
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The Honorable Matt Garcia
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Vice Chairman, House Judiciary Committee
San Antonio, Texas

The Honorable Bill Haley
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Chairman, House Public Education Budget and Oversight Committee
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The Honorable Craig Washington
House of Representatives
Chairman, House Human Services Committee
Houston, Texas

The Honorable Joe Kelly Butler
Chairman, State Board of Education
Houston, Texas

The Honorable E.R. Gregg, Jr.
State Board of Education
Chairman, Committee on Rules, Budget and Finance
Jacksonville, Texas

The Honorable Jimmy L. Elrod
State Board of Education
Chairman, Committee on Investment of the Permanent School Fund
San Antonio, Texas

Dr. Willis M. Tate
Chairman, Governor's Education Action Group
Dallas, Texas

Dr. Calvin E. Gross
Governor's Education Action Group
San Antonio, Texas

Dr. Linus D. Wright
Governor's Education Action Group
Dallas, Texas

Executive Director
Mrs. Cis Myers
Deputy Commissioner of Education
Austin, Texas

Select Committee on Public Education

201 East 11th Street
Austin, Texas 78701
(512) 475-4536

December 20, 1982

TO THE HONORABLE GOVERNOR OF TEXAS
AND MEMBERS OF THE 68TH LEGISLATURE

I am pleased to forward to you the Report and Recommendations of the Subcommittee on Changing Technology in Instruction.

The subcommittee was part of the Select Committee on Public Education, authorized by Senate Concurrent Resolution 22, 67th Legislature, to study the issues and concerns relating to public education in Texas. The subcommittee was charged with studying various methodologies of instruction in our public schools relative to modern and anticipated technological advances.

The Edit and Review Subcommittee adopted the report and recommendations of the subcommittee, as amended, on September 15. The full Select Committee on Public Education adopted the subcommittee report and recommendations, as amended, at a meeting in Austin on September 16.

This report is the result of work by many groups and individuals who devoted their time to the subcommittee. A panel of advisers who were experts in the different fields of technology proved invaluable to this subcommittee and helped research and review data for this report. The Subcommittee on Changing Technology held public hearings to receive testimony regarding technological issues, and many site visits were made to examine different aspects of technology utilized in our public schools.

I believe that the recommendations in this report address areas of concern of educators and the public. The report and recommendations provide much insight into the growing field of technology in our public schools and will promote education in the state of Texas.

Respectfully submitted,

W P Hobby

William P. Hobby, Chairman
Select Committee on Public Education

Subcommittee on Changing Technology in Instruction

Subcommittee Members

The Honorable William W. Blanton, Chairman
House of Representatives

The Honorable Mike Richards
Senate

The Honorable Dr. Calvin E. Gross, Superintendent
Alamo Heights ISD

Subcommittee Advisers

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Mr. Joe M. White
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Select Committee Staff

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THE HONORABLE WILLIAM P. HOBBY, CHAIRMAN
EDIT AND REVIEW SUBCOMMITTEE

THE HONORABLE JOE KELLY BUTLER, VICE CHAIRMAN
EDIT AND REVIEW SUBCOMMITTEE

Dear Governor Hobby and Mr. Butler:

I am pleased to submit the Report and Recommendations of the Subcommittee on Changing Technology in Instruction.

The initial charge you gave the subcommittee members provided the impetus for exploring technology and its potential impact on public education in considerable depth. I believe you will find the results most helpful during the next legislative session.

This report represents the work of many groups and individuals who offered their time and expertise to the subcommittee. We are particularly grateful to the school districts who opened their doors to us most graciously during on-site visits. We are also indebted to the many experts in the different fields of technology who served as advisers to the subcommittee. Their understanding of the highly technical issues proved invaluable.

Please let me know if I may be of additional service.

Sincerely,

Bill Blanton

William W. Blanton, Chairman
Subcommittee On Changing Technology in Instruction

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Introduction

Electronic devices or machines, combined with knowledge of how to use them, constitute technology, an ever-changing, dynamic element in education. An impressive and ever-increasing array of these machines and knowledge of how to use them is available to society and thus to the process of educating children. The use of devices or machines to accomplish or promote learning may be called "technology in instruction." Some of this technology, computer and telecommunications knowledge-and-devices in particular, offer an enticing potential and reality for more productivity at decreasing costs. The viability test for any technology is the point at which a particular technology can produce more accomplishments than an alternative. This is the point at which it begins to permeate any endeavor, whether it be in the private or public sector.

Cable television, calculators, microcomputers, video discs, satellites, and telecomputing represent new devices or systems now available and which are becoming more important to daily life. Only a decade ago such technology was not readily available while today it may be becoming essential as the world enters what is commonly referred to as "the Information Age."

In spite of this explosion of computer use in society, most people know very little about how computers work and may be used. This does not reflect a lack of interest but a lack of literacy. Most people recognize that computers are here to stay and are interested in finding out how to use them.

Today's technology era is the beginning of the Information Age, an age as dramatic as the Industrial Revolution in its ability to change the ways we work, study and play. The growth of technology and information is so rapid that adults as well as children may have their futures dominated by electronic technology. An understanding of and the ability to use technology—to access, manipulate and create information, and to perform work—will be essential.

One major goal of education is to help students prepare to cope with situations they will encounter later in life. Every student will come across new and different problem situtations. Every student will encounter change, much of which will be based upon developments in science and technology. Continued and rapid progress in such diverse fields as medicine, genetic engineering, telecommunications and automation can be expected.

At the heart of scientific and technological progress is the accumulation and application of knowledge. It is here that computers are making a substantial contribution. The rapid progress in computer hardware, software and applications in the past thirty years seems destined to continue at a more accelerated pace in the future.

Thirty years from now it can be expected that inexpensive handheld computers will exceed today's million dollar machines in capability and ease of use, and that there will be large libraries of programs available to perform a continually expanding range of complex functions as well as mundane work.

All elements of schooling have their future tied to technology—ranging from class scheduling to student learning. In a time of receding purchasing power, schools must embrace tools that will provide quality services with declining revenues. Barriers to learning are those that cut off access to information or diminish the capacity of schools to respond to societal and individual needs. Initiative and imagination are needed so that essential skills can be acquired while maintaining an equity of opportunity to expand the learning process. Technology promises much in this regard, but the challenge is to embrace the change as a whole, and to deal with it as a long-range opportunity.

The following information deals primarily with the two most prominent and promising technologies—computers and telecommunications. This is not a failure to recognize the importance of other forms of technology. Indeed, it can be predicted that computers alone will be catalysts for other technological advances and applications such as satellites, video discs, cable television, instructional television broadcasts from public television, etc. The challenge is to effectively manage and use current technological capabilities and to establish a long-range approach to deal with the total management and utilization of technology in education.

National Perspective

There is a striking analogy between the situation today regarding computers and that in Germany in 1492 when the Guttenberg printing press was developed. The new printing press greatly increased the potential of inexpensive books being made available to the masses. However, the masses were illiterate. Understandably they considered the book a complicated device that required much training in order to be used properly. Similarly, computer technology today is entering a world populated by computer illiterates. The single most important impediment to massive use of technology is the fact that the vast majority of Americans are uneducated regarding its use.

As predicted in a 1975 report by the U. S. Department of Health, Education and Welfare, computers are rapidly being purchased by school districts throughout the United States. This report stated, "As equipment becomes cheaper and more miniaturized, it will be widely used at all educational levels and by many segments of the population, from the consumer to the professional, making a minimum of computer literacy a necessary part of the general education of all students." A 1981 school survey by Market Data Retrieval, Inc., confirmed this prediction. It found that 42 percent of the 15,000 school districts surveyed had at least one computer and estimated that the sales of small computers to school districts would probably increase over 300 percent by 1985. In fact, the Technology Education Act of 1982 (H.R. 5573) currently before Congress would, if passed, provide at least one microcomputer for every elementary and secondary school in the nation.

In a 1977 hearing before the U. S. House of Representatives, Arthur Luehrmann pointed out that the United States is the world leader in manufacturing micro-electronic hardware. Since the invention of the transistor at Bell Laboratories in 1950, the United States has led the world in the technology of miniaturizing electronic circuits on silicone crystals. It was forecast that this industry would grow to a $10 billion industry by 1985, an astounding fact, given the comparative decreased growth of other industries such as automobile manufacturing. Today, micro-electronic technology is making powerful personal computers affordable to millions of individuals.

In 1981, a congressional subcommittee report from the House Committee on Science and Technology entitled "Computers and the Learning Society," stressed that the new technologies—computers in particular—can have important effects on the practice of education at all levels.

The concern for implementing educational technology has now been officially mandated. "Education for the new technologies" is a top priority of the Department of Education (DOE), according to statements by U. S. Secretary of Education, T. H. Bell, at a meeting of industry leaders and prominent educators last July in Washington. The conference, sponsored by the DOE, was the first in a series that will define the country's formal policy on educational technology. Bell stated that it is a must for schools to help our young people prepare for massive technological changes in the next 20 years.

The budget for accomplishing this objective has been predicted to be as high as $25 million. The DOE's plans include setting up training institutes for teachers and administrators, encouraging research and dissemination of currently successful practices, and expanding funding for hardware purchase and courseware development. With this mandate, funds have already been made available to state education agencies under Chapter 2 of the Elementary and Secondary Block Grant Program to be used to address basic skills, implement educational innovation and develop special projects.

The DOE has funded a project to increase awareness of state leaders regarding the use of technology to teach basic skills. Project BEST includes video and audio teleconferences, modular training packets, toll-free telephone services, an electronic mailbox system, a microcomputer courseware exchange system, and a listing of state and regional experts for consultation. State teams have been developed to assess their individual state's needs and to contribute suggestions and information about exemplary programs. The project encourages cooperation and sharing of information among states and local school districts. It is under the guidance of the Association for Educational Communicators and Technology, a national association of professionals formed to improve instruction through media and technology.

Virtually everyone who has written on the subject agrees that the potential for utilizing technology in instruction is enormous. However, there is much less agreement on how this potential can be realized. Japan, for instance, is teaching computer literacy much more extensively than the United States at the pre-college level. If this is a universal trend, then people in countries like Japan would quickly become more knowledgeable than Americans in how to apply computer technology.

Chapter 1 of the Elementary and Secondary Education Block Grant allows the acquisition of equipment and materials which might include microcomputers, courseware, calculators and video discs required to imple- ment a compensatory instructional program for migrant and/or disadvantaged children. Chapter 2 of the same Act consolidates over 20 programs and allows the purchase of these same instructional resources and equipment if required to implement these programs. Both Chapter 1 and Chapter 2 provide funds for teacher training and inservice staff development which might be used to develop competencies in teaching with technology. (REF: Omnibus Reconciliation Act of 1981, Chapter 1 Sec. 552; Chapter 2 Sec(s) 561,577)

The federal laws governing vocational education and special education are very similar in scope. Both programs may acquire any special equipment and materials necessary for the implementation of their program. Similar provisions are provided for staff development and teacher training. (REF: Public Law 94-482, Sec(s) 130, 195, Public Law 94-142, Part B, Sec(s) 4, 163, 653)

Other federal monies such as Title IV-C, Migrant, Gifted and Talented, etc., allow for the purchase of microcomputers and other technologies within the specific guidelines of particular funding sources. In addition to encouraging creative uses of technology, these guidelines address the question of equity of access in that they provide the means whereby less wealthy school districts can afford the cost of technology.

Other States

At the regional level, the Southwest Educational Development Laboratory (SEDL) estimated that in their region the percentage of school districts in each state with microcomputers is as follows:

Arkansas:	23.32	New Mexico:	39.36
Louisiana:	37.84	Oklahoma:	22.45
Mississippi:	36.94	Texas:	25.66

This survey was done in the summer of 1981 by Market Data Retrieval. It was a nationwide telephone survey of 15,000 school districts.

Southwest Educational Development Laboratory has started a project to strengthen the state departments of education by increasing their leadership capability and establishing a technology center in each state department. The National Institute of Education funded this three-year project and is already providing seminars, staff development and computers to state education agencies in the southwest region.

A 1981 survey by Electronic Learning magazine listed eight states as leading contributors to the development of computer education. These states were Alaska, California, Delaware, Florida, Minnesota, North Carolina, Texas and Pennsylvania. Minnesota is considered the most greatly involved with its Minnesota Educational Computing Consortium (MECC) established in 1973. The Consortium was established for two major purposes:

1. to coordinate and plan computer services, and

2. to supply information regarding these services to participating school districts.

A management information services divisions has seven regional centers throughout the state. The Consortium has developed software for the centers. Data is sent on computers from school districts to the regions and from there to the state education department. School districts are linked through a telecommunications network. All of the school districts in the MECC have microcomputers, and it is estimated that 95 out of 100 students are exposed to computers by the time they leave school. No other state education agency comes close to achieving the kind of commitment or organization achieved by MECC, but many school district officials are now moving in that direction. For example, Florida has mandated that their state department promote computer literacy by providing information, conducting surveys, establishing contracts and evaluating equipment. Oregon has established objectives for computer literacy in kindergarten through the 12th grade. Hawaii is proposing a similar mandate, as are Delaware and North Carolina.

Texas Perspective

Texas is considered among the leading contributors to the development of electronic learning. Funds have been made available through the Texas Education Agency to the Regional Educational Service Centers to increase support to local school districts using computers in their instructional program. In order to understand the pattern of growth in the use of computer technology in Texas it is necessary to understand the role Education Service Centers play in the Texas education system.

Regional Education Service Centers provide certain programs and services which are supported by state categorical funds. Other activities are provided based on the needs of districts in a region, the availability of federal funds and the capabilities of the Education Service Center staff.

Regional Education Service Centers are intended to provide desired educational services to school districts more efficiently and economically than can be provided by individual school districts. These regional services make a significant contribution to equalization of educational opportunities and to improving the quality of education for public school students throughout the state. They also provide a statewide system of computer services for school management. Participation by school districts in these regional computer services has grown steadily since the early 1970s. Basic services include: student master files, class scheduling, test scoring, grade and attendance reporting, payroll services, personnel and financial accounting, and ad valorem tax accounting. School district participation in the services is voluntary.

Regional Computer Services:

All ESCs provide these services which include the following:

Student Services	Number of Districts
class scheduling	179
grade reporting	179
attendance accounting	126
test scoring and analysis	432

Business Services	Number of Districts
payroll accounting	395
tax accounting	215
financial accounting	266
personnel accounting	26
Total number of public school districts using 1 or more computer services	739

State funds provide approximately 17 percent of the total support and 83 percent comes from school districts that choose to participate in selected services. Funds are expended for hardware costs, personnel who operate the computers and interface with local school personnel (help them understand and get better use from the services), and communication costs.

Like school districts in other states, the pattern of computer use has grown in a relatively sporadic manner. It is common knowledge that over the past several years the state of the art in computer technology has advanced to the point where computing power is quite affordable at both the individual and school district level. While large computers have proven their worth to central offices in many school districts by performing bookkeeping and financial functions, a new generation of microcomputers has been making its way into school districts to assist in actual instruction.

Since there was no single source of information on the number of microcomputers in Texas schools, there was no central source from which to glean information regarding the many different ways in which school districts could be using computers. Equally important, there was no data base on the readiness of school districts to use computer technology or their awareness of its potential uses. It was these concerns that led migrant personnel, in a consortium of Education Service Centers, to initiate a survey in April 1981, which sought information regarding computer use in public schools in Texas. Some of the major findings included:

- 40 percent of respondents indicated using computers in the classroom while 20 percent indicated using them for data management and analysis.

- In districts reporting computer usage, classroom use had been for an average of two and one-half years; data management and analysis had been for an average of four years.

- Although larger districts were more likely to use computers, computer usage was not limited solely to them; 10 percent of districts with an ADA of under 500 in statewide response used computers in the classroom.

- Education Service Center consultants were named by over 50 percent of respondents as a major resource in determining which computer to use.

- Local committees involving superintendents, principals and teachers were used in nearly one-third of districts in selecting computers.

- No single source of funds was typically used for computer purchase/ lease. Instead, a combination of funding sources was used.

- For both data management and classroom use, a wide variety of computers, microcomputers and peripherals were used.

- Microcomputers were most frequently used in classrooms; mainframes and minicomputers were most frequently used in data management and analysis.

- Software was most frequently purchased from computer manufacturers and software firms, rather than self-developed.

- Computer Assisted Instruction (CAI) programs occurred at all grade levels and in all sizes of districts, most frequently being math-related.

- Forty-two percent of the respondents indicated that their district was considering computers for CAI, 28 percent for data management use. However, 29 percent of all respondents had no plans for computers in their district.

- Seventy-eight percent of all respondents expressed an interest in their district learning more about computer use in education.

Results of the consortium survey highlight the important role of the 20 Regional Education Service Centers in providing guidance and training to local school districts in the area of computer technology.

Current state education laws and statutes allow the use of educational technology. Most of these laws refer to the accruement of instructional materials or media necessary to implement instructional programs. Gifted and talented programs, pilot summer school programs, teacher education centers, state compensatory programs for the improvement of basic skills, and instructional television services all have individual statutes allowing the purchase of instructional materials. These instructional materials could include video discs or computer courseware. Equipment such as monitors or computers necessary to implement these instructional programs may also be purchased according to some of the statutes. Any necessary equipment may be purchased with excess state and county funds according to the law authorizing expenditures. (REF: TEC Sec(s) 16.501, 16.502, 16.521, 11.311, 16.176, 31.915, 20.48)

Only one law directly refers to the use of computers. This statute directs Regional Education Service Centers to provide computer services as required to meet the needs of school districts. It could be interpreted that these required computer services are instructional needs since instructional computer needs are not forbidden. (REF: TEC Sec 11.33(b))

Regional Education Service Centers also provide a variety of other regional computer services. These services are optional and are not eligible for the state support allotment. Optional services include inventory control and systems for bus maintenance, bus routing and textbook accounting. State-of-the-art capabilities such as distributed processing and on-line file update and inquiry are also being used by an increasing number of districts.

One of the first steps in the direction of coordinating the rapid proliferation of microcomputer technology was taken by the Region IV Education Service Center which provides services to 101 school districts in Texas. It established a Microcomputer Task Force to study the rapid proliferation of microcomputers within the Houston area schools. A preliminary survey of microcomputer use led to a recommendation that, while the hardware had the potential to make computer instruction more cost effective, there was little software and maintenance support to justify the use of microcomputers. A position paper was written to present microcomputer developments and recommendations for action. This report identified several considerations for administrative decision making:

1. The microcomputer had the potential for increasing the cost effectiveness of instructional computing over and above that of the timesharing terminals which had been in schools for the past five years.

2. The mass media was advertising low cost microcomputers. While interest in purchasing them was high, there was little understanding of their potential and limitations.

3. Many administrators purchased microcomputers with insufficient planning. After purchase, they discovered problems associated with the use of these microcomputers, including a shortage of software and documentation, and lack of training and technical support for operation and maintenance. A coordinated plan for assistance was needed.

In addition the position paper made recommendations for action:

1. Hardware should be standardized within Region IV since software was not transportable. This standardization would accomplish several objectives: (1) facilitate software exchange, (2) conserve human resources for training, (3) simplify maintenance arrangements, and (4) increase communication about the hardware selected.

2. High volume purchases should be pursued in an effort to save schools money on the purchase of hardware.

3. Bid specifications should be developed for a microcomputer system which could be used for instruction and which had software to support it.

The recommendations listed above were implemented over a nine-month period. A state-of-the-art paper, "Microcomputers in Education," was distributed to 500 administrators in February 1979. Workshops were conducted to apprise administrators of the issues involved so that they could take a more systematic approach. In March 1980, bid specifications were finally released.

In June 1980, Bell & Howell's Apple II Microcomputer System was selected. Within 18 months, 323 microcomputers were purchased after the decision had been made to standardize equipment. Approximately $350,000 was saved on hardware purchased due to high-volume discount.

During the following two years, teachers and administrators attended inservice training sessions. In general, the demand for training by teachers exceeded that which could be supplied by the Service Center and school districts.

Local Perspective

The powers granted to local school districts by state laws and statutes are sufficiently broad to authorize the purchase of any equipment or materials necessary to the implementation of the instructional program. Excess state and county as well as local funds may be appropriated for this use. School districts may also join together for the mutual purchase of necessary equipment and materials including microcomputers, cable television, video discs and courseware. (REF: TEC Sec 23.26, Art. 4413 (32 c))

As previously noted, proliferation of computer technology has occurred in public schools in recent years. Documentation of the increasing rate of this uncoordinated growth is provided by the results of a survey conducted by the Select Committee in July 1982. Many of the same issues addressed in the April 1981 study, conducted by the Educational Service Center Consortium, were repeated in the recent survey.

The most recent information relative to changing computer technology at the local district level is part of a survey conducted in July 1982 under the auspices of this subcommittee. Answers to questions concerning the adoption and utilization of computer technology from approximately 600 respondents, representing the diverse characteristics of size, wealth and geographic setting of Texas school districts, indicate that some of the findings of earlier studies continue to be supported while other conclusions no longer reflect activities taking place at the local level (see Appendix B for data tables). Presently over half the districts have microcomputers and 65 percent of all districts utilize computer technology. By way of comparison with the April 1981 survey, recent noteworthy findings include:

- Instructional use continues to exceed administrative use with 56 percent of respondents utilizing computers for instruction compared to 43 percent for administration, with most making combined usage.

- For districts reporting computer usage, 65 percent have fewer than four years experience.

- Although larger districts continue to be the predominant users of computers, half of the rural or small town districts have computers and 42 percent of the districts with an ADA of under 500 now utilize computers.

- Thirty percent of respondents rely solely on user recommendations as compared to only 10 percent relying solely on either Regional Education Service Center consultants or committee recommendations in the selection of course software. Almost half the districts rely on a combination of sources in their decision process.

- Twenty-five percent of districts employing computer technology have mini or mainframe computers.

- Instructional use of computers occurs at all grade levels in over 50 percent of the districts with computers, while an additional 40 percent use them only at the secondary level.

- Over 60 percent of respondents support computer literacy requirements in teacher training. However, small and rural districts raise concerns reflecting the over-specialization of teacher certification requirements.

- Less wealthy districts, as measured by tax base on a per pupil basis, and districts with higher tax rates, i.e., in excess of $1.00/$100, have proportionately higher rates of adopting computer technology.

- Forty percent of all districts utilizing microcomputers have at least ten computers.

- Districts with less than 1,500 ADA, representing rural and small town settings, have proportionately less involvement with computer technology.

- Three-fourths of the districts presently not utilizing computers cite lack of funds as a reason.

- Over 80 percent of respondents rely on Regional Education Service Centers for some type of computer service and 65 percent receive a combination of services.

Other Technology

While not as dramatic as the growth in computer technology, similar issues exist relative to telecommunications technology of which there are a number of devices and systems including cable (a generic term, not limited to television pictures), satellite, telephone, radio, broadcasting, videotape recorders, video discs, teleconference, data transmission and electronic mail. Typically, schools have been involved with broadcast television, as has most of society. However, cable technology now connects 29 percent of the homes in the United States. In Texas over 400 communities have cable systems. A cable can carry over 1000 times more information into the home than can a pair of telephone wires. Not limited to television, such cable connects computers for distant library and information services, security services, and electronic mail. Most schools are connected to cable systems in communities where they exist. But schools are not sophisticated users, partially because the services/content offered is not appropriate to the curriculum or for teacher support, and partially because of the lack of resources and experiences to develop the potential in the technology.

Cable systems are interconnected by satellite and terrestrial microwave and phone lines. Failure of the school system to use this type of technology as a major delivery system is attributable to lack of organization, imagination and diversity of resources. In the Dallas region of the state, however, a group of schools has made significant use of cable to support instruction. Houston Independent School District is also using dedicated cable system to link its campuses, and there are other schools moving into similar linkages.

Direct satellite to school or home has been demonstrated in Japan and Canada as a practical delivery system for teltext and television. Such systems use a two or three foot diameter rooftop antenna and, as with all satellite systems, deliver messages as cheaply across thousands of miles as across town. DBS (Direct Broadcast Systems) are not yet operational in the United States, although permits to construct them are applied for by six companies before the Federal Communications Commission. Leased channels for educational services will be available on DBS just as they presently are on extant satellites such as WESTAR IV and V. Most PBS (Public Broadcasting Stations) now serving schools are linked to satellites such as WESTAR. The satellites now in orbit have transpone space, usually meaning about 24 channels, transmitting to various ground receivers by the hundreds. Alaska makes more extensive use of this technology for its educational system than any state. There are now 80 global satellite stations in orbit and over 12 more planned. Obviously the technology is viable. Costs per message-unit delivered continue to fall at 20 percent per year—more work for less money.

Schools in Texas have used instructional television since the 1960's. Although there is no central broadcast system such as is operating in a few other states, the number of school students being served each year has continuously grown at around an eight percent rate each year since 1966. For the 1982-83 biennium $2,542,438 was appropriated for educational television. Instructional television content has primarily been via cable. A limited number of schools have benefited from cable by getting more than one channel. One system in the Dallas area—RITC—serves over 27 school districts with four channels per day and is moving to include computer linkages and services via their system. Because the system is in place they have potential to offer library services and one-way intra-school mail as well. Since the system also connects to homes (cable subscribers) the potential for off-campus and homebound service is limitless. Operating in consort with the Regional Education Service Center the electronic delivery of film content, texts, and other information is a potential service.

In the Houston area, the Region IV Education Service Center has recently been granted approval by the Federal Communications Commission to construct an Instructional Television Fixed Station. This is the first new construction permit ever issued by the FCC for a 50 watt, four-channel ITFS network. Like the Dallas area project, this is a comprehensive regionwide telecommunications system that has been planned in cooperation with area school districts, colleges and universities, business and industry. Its goal is to provide cost-effective instructional television programs and classes for school districts, area businesss and industry, and the general public. Additionally, the system will be interactive. A "talk-back" television system will enable teachers, administrators and the public to take college and university courses leading to advanced degrees and/or professional certification. Videeo and audio transmission will originate at the Region IV Education Service Center and at participating college and university instructional classrooms, and will be routed to receiving classrooms in school districts and companies. The project will operate on a self-sustaining basis by charging annual subscription fees to companies and local school districts, time slot fees for broadcast time, tuition surcharges to course registrants, fees for studio use and other services. Additional funding will be requested for grant and proposal funding for special projects.

The survey conducted in July, 1982 found that over half the districts do not utilize television in the classroom. Reasons given for not utilizing were equally split among lack of available service, expense limitations, a combination of the two and lack of interest. Most districts involved in classroom television use rely on a variety of sources for programming and over two-thirds use television in all grades. Again, as with computer use, rural and small town districts make less use of technology.

With the advent of such distribution systems as satellite, terrestrial, cable or broadcast has also come devices for capturing and displaying the information sent. The same devices can also be used for creative expression, for communications via picture, icon and sound as well as text. They, like the computer, are not just storage and delivery technology—they are also creative and productive tools. Videotape recorders, computers, xerography, and digital printing devices are common examples of capture/display devices. These allow individual teachers flexibility in what to use and when, and are not so demanding on months-ahead planning as was the television in pre-recorder days. Computer programs, too, can be sent and captured over such telecommunications systems—indeed the symbiotic relationship of the technologies is astonishing.

Just as the industrial revolution had an effect upon the size, shape and curricula of schools, so, too, will the technology era and Information Age. The connections between business offices, bank branches, financial networks and worldwide company meetings via telecommunications are likely predecessors to interlinked schools and information-accessing units at work and at home.

These electronic devices deliver information and provide a service to geographically dispersed users while simultaneously meeting individual needs. User control of devices can be exerted at many points since the individual ultimately has control.

Computer Applications

Teaching With Technology

Teaching with a computer as a medium of instruction requires reliance on courseware—computer programs that give the computer step-by-step instructions, including what to display on the screen, what responses to expect from students, what feedback to give students, and what type of records to keep, if any. Currently there is a varied supply of courseware available and a great deal more is expected in the future. The courseware designed to help students attain educational objectives is for a range of curriculum areas including music, reading, social studies, mathematics, foreign language and science.

Computer Assisted Instruction

Computer Assisted Instruction (CAI) can be used to supplement almost any instructional content area. The Northwest Regional Educational Laboratory in Portland, Oregon, summarizing recent studies on the use of computers for instructional purposes, concluded that almost all studies reported that traditional instruction, supplemented by CAI, led to higher achievement than traditional instruction alone. This finding held true regardless of the content area being studied. Current uses of CAI include the following applications:

- **Drill and Practice**

Drill and practice courseware is currently the most common. This type of program usually asks a series of questions or lists problems to be solved by the student. Often, this type of program is used to reinforce basic skills.

However, not all drill and practice programs are identical in format, structure, reinforcement, record keeping, or response time. Some display a certain number of questions and/or problems and tally the results of the student's responses. Others allow the teacher to determine both the number and nature of the questions or problems. Some programs require that a student work through the entire series of questions while others allow students to skip some questions or to move to another part of the program. Almost all drill and practice programs provide some kind of feedback to the student. Feedback can vary from as simple a response as "Correct" to an elaborate pictorial rewarding the correct answer with an airplane flying across the screen carrying a banner saying "Congratulations." Some programs provide as diagnostic a response as "Your answer is correct; however, the correct spelling is Hawaii." It is important to remember that drill and practice programs can only be used as a reinforcement for the instruction already provided by the teacher.

- **Tutorial**

This approach to computer-assisted learning provides more instruction than drill and practice programs. Tutorials usually do their explaining with words on the screen although some may use graphics to explain a concept. These programs usually go beyond a simple "Right" and "Wrong" feedback message. Instead, the student is provided with an explanation of why the answer is incorrect and receives more instruction or repeated instruction from the computer. If the student has demonstrated mastery at a particular level, the student is "branched" to a more difficult level. Tutorials are more flexible than drill and practice as students are allowed to move or branch to various parts of the lesson for help or definitions and then return again to the lesson. Often the student can control the reading rate and can revise work previously completed during a session.

- **Simulation**

Computer simulations model real-life or make-believe situations which otherwise would be impossible to bring into the classroom. Simulations can show the results of manipulating variables without really having the variables to manipulate. For example, students can conduct what would be an expensive or potentially dangerous experiment by manipulating the variables programmed on a computer, and the computer will show what would happen as a result. Also, students may role play as a pioneer, presidential candidate, sea captain, stockmarket tycoon or ruler of an ancient kingdom, make decisions pertinent to the role, and instantly see by means of the simulation program the short- and long-term effects of their decisions. Simulations have the capability of becoming powerful instructional tools in the social science and science areas.

- **Problem Solving**

Courseware that teaches problem solving usually combines the techniques of tutorial and simulation programs. Solutions are to be discovered for unique problems that are often simulations of real-life problems. Clues or steps to follow are often incorporated in this type of activity. The higher cognitive skills of analysis, synthesis and evaluation are often incorporated in this type of activity. This use of the computer embraces the most powerful learning potential of this technology.

- **Authoring Languages**

There are also programs available that allow teachers to create their own drill and practice, tutorials, simulations, or problem solving courseware. These programs or author languages make it possible for teachers to present a text, ask questions, respond to various expected and unexpected responses, advance the student to the next question after a specified number of tries, and keep score for the session. Some author languages allow the teacher to include graphics or even video segments in the lesson; some keep extensive student records, and a few can find the correct answers anywhere within the text of the student's response or can decode incorrectly spelled answers. These programs allow the teacher to "program" the computer without knowing any programming languages and may become an increasingly important tool for educators.

- **Computer Games**

Computer games are being used to teach both instructional content areas and for pure entertainment. Educators are concerned as to whether the game format in instructional software is helpful or distracting to the objectives of the lesson. Thomas Malone, in a 1980 study of computer games, found that the characteristics that make computer games intrinsically interesting fit into one of the following three categories:

- Computer games are challenging. The existence of a goal with an outcome that is ultimately obvious is personally very satisfying to most students.

- Computer games are fanciful. They create an environment where players use their skills to get involved in real-life games such as baseball or in a fantasy or adventurous process.

- Computer games tease curiosity. The environments that they create are novel and surprising. The players do increasingly complex tasks, but tasks that are usually within their ability.

In this study, Thomas Malone found that drill and practice programs quickly become boring to children who find the work either too difficult or too easy. (This has been a severe criticism of traditional CAI programs.)

Computer Managed Instruction

As a tool for instruction, the computer may also be used to provide diagnosis, prescription, data collection, data reporting and correlation of instructional materials. Such computer usage is generally referred to as computer managed instruction (CMI). There are a variety of software programs available for these purposes including record-keeping, test-preparation and grading. CMI software should not be confused with CAI courseware; their content, structure and purposes are different. Some CAI courseware may have an integral management system but not the capability for extensive record-keeping, diagnosis or test generation. Because of the immediate increased efficiency provided by computers for management purposes, school districts have more easily embraced computer technology in administration. The benefits of computer technology in instruction are not equally obvious.

Teaching About Technology

Teaching those skills specifically linked to operating the computer must focus on using it as an object of instruction. These skills fall under the headings of computer literacy, computing science, programming and word processing. Vocational skills such as computer operations, data entry and computer maintenance are also implied.

Computer Literacy

The precise definition of computer literacy has changed over time. Its initial definition—now termed "computer awareness"—means a basic level of understanding, enabling a student to talk about computers but providing little or no hands-on experience. Computer literacy is now defined as an understanding of what a computer is, what it can do, how it works, its history and its role in society. A computer literacy course usually introduces students to one or more programming languages, interpretation of computer programs and output, and the technique of computer programming, as well as providing students with actual working experience with the computer in the BASIC language.
Students are trained to deal with the problems and opportunities that will be handled by the computer in the near future in the areas of business, government, daily life and recreation. While becoming computer literate does not require advanced programming and technical expertise, the opportunities for such advanced study should be offered in any computer literacy course.

Computer literacy is a fairly new concept, and the importance of its role is just beginning to be understood. Course content, teaching methodologies and when students should be introduced to the computer, are issues which are becoming important in many areas of education. A student may come in contact with a computer—such as in a computer-assisted learning situation—without having to know much about computers. Once that student's interest is piqued, however, and programming and problem solving become part of the student's interaction with the computer, more knowledge of the computer is required—on the part of both student and teacher.

Computer estimates show that computer-based automation of manufacturing in the United States will eliminate ten million jobs over the next 20 years. Offices of the future will utilize word processing, computerized information retrieval and electronic mail. The knowledge and skills needed to function in an automated environment are far different from what most students acquire in today's schools.

A student who understands these societal changes will be prepared to function successfully in the future. Students' decisions on education and career goals must take into consideration how computers will affect the job market, the types of jobs available and the world in general. An understanding of these issues is an important part of computer literacy.

Computer Science/Programming

Computer science goes beyond computer literacy to include a higher level of understanding of computer systems. This involves software development, the use of computer systems in solving problems, and the design and operation of computer hardware. Developing software and using computer systems to solve problems require a knowledge of programming. To program a computer, a person must use a language that consists of instructions that the computer can "read" and rules for arranging these instructions so that the computer will interpret them in precisely the way they were meant to be interpreted. Hundreds of programming languages are presently used, including BASIC, FORTRAN, COBOL, PASCAL, PL1, PILOT and LOGO. A programming language is usually developed for a specific purpose; for example, FORTRAN is used in science and engineering, COBOL is used for business applications, PL1 and PASCAL are used throughout the sciences. A knowledge of the design and operation of computer hardware enables existing languages and software to be improved or new ones to be developed.

Word Processing

This use involves using the computer as an electronic pencil, pad and eraser for the creation, editing, storing and sometimes printing of text. A computer can function as a word processor with the appropriate software. The programs make it possible for the computer to understand simple commands used to edit any text that has been entered through the keyboard and displayed on the computer or terminal screen. For example, words, sentences and paragraphs can be rearranged, corrected for spelling errors and personalized for a number of recipients by filling in a few blanks that have been left in the letter. Word processing may become the "writer's tool" for students in composition classes.

In addition, computers currently on the market may incorporate additional features and peripheral hardware devices including: graphic tablets which allow the user to draw any visual with shading and detail and transmit the drawing directly to the screen; speech generators which allow the computer to "talk" through voice synthesization; voice recognition devices which allow the computer to recognize a set of spoken words; music generators which allow music to be composed, played, stored, manipulated, transposed and added to while colored bars representing the musical sounds are displayed on the screen.

Issues Regarding Technology in Education

Technology is accelerating as evidenced by new devices and related knowledge. It is expected to continue to accelerate. As a result of its symbiotic relationship to technology, information is doubling every decade—each breeds the other, producing a seemingly infinite resource. If the United States is to remain competitive in its production of information, it must use its information technology to the maximum, including teaching its use in school as well as using technology to improve the productivity of schools. Yet the public school system is ill-prepared thus far to either teach the necessary skills or use the technologies available and yet to come. This weakness is illustrated by a variety of issues.

Organization

Being everyone's business, technology becomes nobody's business in schooling. Every curriculum area and instructional department has an interest in the use of technology, but left to everyone it becomes pieces of an information delivery system, pieces of curriculum and pieces of particular domains rather than integrated parts of a whole. The appearance of a new technology thus may start a confusing and counterproductive struggle for who will manage it, infuse it, train in it, etc. For example, the appearance of a few computers may start a struggle between academic curriculum, people versus vocational, data processing and library personnel. Whether overt or underlying, the struggle is a reflection of a general lack of an agreed upon philosophy for educational technology.

Of critical importance is the caution that another layer of administration, that of the technocrat, not be added to an already burdensome administration. Technology in education must be coordinated, infused with already-existing content areas so that all will learn to use technology appropriately within their respective disciplines. It would be an educational disaster to lay the groundwork for a math department and a "computer" math department, for an English department and a "computer" English department.

Making technology work for increased educational productivity is a challenge and opportunity for the state public school system. There remains the challenge of establishing a subsystem within the school system for dealing with technology as an important whole element rather than pieces.

Budgeting and Funding

The budgeting for capital outlay on technologic devices has traditionally been departmental and thus diffuses a system-wide focus on the total use of technology. While recent studies show that poorer districts have proportionately more involvement in computer technology, as measured by the number of districts adopting computers in either instructional or administrative utilization, wealthier districts still appear to be innovators in terms of unique applications.

This lack of a focusing or binding philosophy for educational technology results in management confusion, policy inadequacies and general waste regarding the adoption of technologic tools and in teaching technologic skills.

Funding for educational technology may flow simultaneously in several directions supporting teacher training. Funding sources may be categorical as for books, television, media computers, going into library programs, vocational units, language arts or science programs, and into special programs for migrant or special education. All these educational programs are technology users and directly or subliminally teach certain technologic-user skills.

Such diversity can be a strength or a weakness regarding the overall effectiveness of the school systems' use of technology. Too often, however, the effect is to diffuse systematic and comprehensive planning and implementation. Scattered funds cannot be regathered to support large-scale information management/delivery systems, combined media/technology tools applications, developmental projects and the like. (Consider the resulting savings to districts through Region IV's bid process.) Apparently the coalescing of technologies into school service, electronic mail systems, alternative schooling sites and technology-based learning systems await development from the private sector before schools can plan for or develop their own.

In the absence of a philosophic basis regarding educational technology, there is also a lack of sufficiently large and focused funding for educational technology to allow statewide planning, development and implementation of programs for technology. School managers are inexperienced with treating technology as comprehensive systems or with refocusing a variety of funds onto technology uses and related skills. Some program restrictions keep managers from concentrating their funds on technology for the common good. Such restrictions defeat administrators interested in comprehensive planning and use of available technologies. They may also limit the cost-effective use of equipment by allowing it to remain idle when not being used for a specific program

In addition, the percent of the total schooling budget which is allocated for equipment and courseware (including books) acquisition, teacher training in educational technology skills, and information delivery systems, is inadequate. Estimated to be between 2 and 4 percent of the budget of a very information-oriented endeavor, it is nowhere near the traditional 8-12 percent for capital equipment costs alone in major industries and businesses.

By the same token the costs for educational technologies such as telecommunications and computers have gone down 20-30 percent each year while their work capabilities have increased. Indeed, instructional materials and equipment, information and its delivery, are "best buys" in an increasingly expensive enterprise.

Staffing

Andrew Molnar has stated that the next great crisis in American education will be that of computer literacy.* Citing the shift from an industrial society to an industrial-based society together with the international challenge to U.S. technological leadership, he makes a compelling case for computer literacy and indicates that the single most important reason for America's decrease in technological world leadership will be the inability of its schools to teach present and emerging generations of students how to function in a technologically oriented world. In order to rise to this challenge it is imperative that teachers and administrators be trained immediately to understand the uses of a computer, how to use a computer in instruction, and how to teach about a computer. It is essential that the educational system be modified in such a way that every student (every perspective citizen) become acquainted with computers and the current and potential role that they play in our society.

It is also important that some effort be directed toward providing information about technology to adults. It is already the case that many children are far more computer literate than their parents and, in many cases, than their teachers as well. It may be imperative to bridge this new kind of generation gap by providing relevant computer information through existing delivery systems such as community and adult education programs and parent/teacher organizations.

One of the reasons teachers and administrators have been slow to learn about computers is fear of the unknown, fear of replacement, fear that is a combination of "math anxiety" and the assumption that computer work lies primarily within the area of mathematics teachers. Teachers and administrators can reduce and eliminate these fears by learning more about microcomputers and having hands-on experience with them. The microcomputer itself will help because the equipment resembles a cross between a typewriter and a television, and in that sense it is somewhat familiar and comfortable.

Given the present shortage of teachers, particularly in the areas of mathematics and science, it becomes a critical issue to consider how sufficient numbers of computer literate as well as computer science teachers will be recruited to step into the teaching ranks. Serious coordinated planning, the development of short- and long-range goals, and the expanded allocation of resources for massive computer literacy training will be needed in order to meet this challenge.

*Andrew Molnar, "The Next Great Crisis in American Education: Computer Literacy," AEDS Journal, Association for Education Data Systems, Volume 12, Number 1, Fall, 1978.

The role of support staff for implementation of computers and technological systems raises another interesting question. The importance of support staff depends on the particular district's level of commitment to instructional computing. If a large district is going to stay on top of changing technology, leadership must exist as well as the technical expertise. Some districts are hiring teacher aides to operate computer labs while others are hiring computer specialists at high administrative levels. Still other districts are relying on Education Service Centers to provide the technical expertise needed to implement these new programs.

If districts choose to implement computer programs with existing staff, then appropriate job descriptions may need to be changed so that it is clear whose responsibility it is to keep up with the state-of-the-art, to find and catalogue needed courseware, and to maintain the equipment. For example, centralized computer maintenance is a function that could be most economically provided by Education Service Centers. They already possess transportation for the delivery and pick-up of media. Vendors of computer equipment would have only one contract to deal with and the administrative burden would be removed from the schools.

Courseware

In the area of software or programs to control the machines there has been tremendous growth, but it is only starting. Expenditures on computer-based instructional materials for schools is projected to be $500 million nationally by 1985. This approaches current national figures spent on all textbooks. Who will produce such materials, what will be their pedagogic soundness and where will the money come from? These are unanswered questions. Costs range widely for producing instructionally sound courseware, but some projections are up to $10,000 per instructional hour. The cost of computer software has been rising steadily and is expected to continue to rise for quality material. This pattern has also been true for books, film, television and other instructional materials.

Computer assisted instruction (CAI) has been in limited use since the 1960s but has grown rapidly, particularly in mathematics teaching since the late 1970s, somewhat paralleling the proliferation of small computers. However, good programs for CAI are not widespread. School uses for CAI are dominated by a small range of programs and by drill and practice materials. Beyond math programs a much wider scope and range of CAI programs are now beginning to appear, supported in part through traditional textbook publishers and in part through major microcomputer company efforts.

Problems with computer software and courseware abound, but are not atypical of problems with other instructional materials. There is, however, more educational experience with most other media and thus perhaps more assurance in the processes used for selection and use of the materials. Also, computer-based instructional materials tend to have more factors to consider. For example, book sizes are fairly standard within parameters, film formats are standard, videotape is fairly standard, but computer courseware—even though on standard-looking discs, cassettes or modules—has a fairly large range of incompatibility—i.e. often can be used on only one type (brand or model) of computer. Computer materials have a host of other unique characteristics which set them apart from film or books. The appearance of the interactive video devices has spawned another new breed of instructional materials. These, too, as they proliferate, will cause recurring selection/evaluation problems. Each new type of software, medium or instructional material has unique characteristics. How to evaluate them is a recurring issue for the school system.

Processes, criteria and training for review and selection of computer courseware must therefore be established throughout the school system. However, in fairness, pre-existing instructional materials have not received the same attention regarding their quality. A system for all types of device-based materials selection would be desirable.

Student Accessibility

If present projections for computer sales to schools are accurate, there should be a 300 percent increase by 1985. Of these computers, many, perhaps most, will be used to teach computing skills in vocational and business education courses and in computer mathematics. This means that very few students will have regular access to a computer for as much as 20 minutes a day. While ideally all students should have access to a computer, the limited number of computers available in most schools make computer hardware a limited commodity. It will therefore be imperative that administrators give careful consideration as to which students will have access to them. If only certain types of school districts can afford computers in large numbers, then only children in these districts will have full access to computer literacy. If only gifted and talented students have access to computers then an elitist image may develop concerning computers and their application. The question of equity of access certainly surfaces as one of the dominant issues connected with computer usage.

Curriculum

Examinations of the curriculum in Texas public schools has resulted in various swings of the pendulum from demands that societal as well as academic elements be taught to every student to a "back-to-the-basics" movement aimed at improving student achievement in reading, writing and mathematics.

Chapter 21, *Texas Education Code* was basically revised through the passage of H.B. 246, 67th Legislature, and is a response to concerns expressed throughout the state, regarding what **must** be taught to every student. Is every subject of equal importance? Is there sufficient time in the school day to teach **everything**? and to teach it well? These are issues which the State Board of Education is mandated to address where defining essential elements in major content areas.

In addressing the area of computer technology, the question of where it fits into the curriculum must be raised. Some of the important issues are:

- Should computer software focus on Texas Assessment of Basic Skills (TABS) objectives? While such support could provide assistance to classroom teachers, it should be pointed out that drill and practice type software, by its very nature, concentrates on lower level skills rather than the higher-level skills educators are trying to strengthen.

- Can technology in education be coordinated with H.B. 246 curriculum elements? While major efforts are underway throughout the state to strengthen and coordinate curriculum requirements in all content areas, technological proliferation should not continue without regard for the state's curriculum reform.

- How will large-scale implementation of technological media in the classroom impact curriculum and the instructional process? Whether we are talking about technology as a tool to teach content or as an instructional management tool, care must be taken to focus on the objectives of a particular content area. In either case, teachers who traditionally have controlled the direction of instruction may have to relinquish some control to the computer system. Software can direct instruction without intelligent planning, thus the computer program's objectives, rather than the teacher's, may dominate.

- Another area in which the impact will be tremendous is with the computer as an object of study. Just what is it about computers that a 4th grader should know? . . . a 6th grader? Should the 4th grade teacher add on to what the 2nd and 3rd grade teachers have done in this new content area? And is such thinking even appropriate? Educators are used to talking about content areas in K-12, or K-6, or one unit of credit. But we can't assume that there is a corresponding scope and sequence to computer knowledge. It may be that computer usage is not really a cumulative set of skills in the same sense as traditional content. Other issues in terms of curriculum include where to fit computer literacy into the curriculum (mathematics? business education? English?), at what level and who will be certified to teach it.

Computer Costs

The cost for microcomputers is as varied as the number of different devices found in the marketplace. Like all computer hardware, the cost of microcomputers continues to decrease dramatically. Timex Corporation now offers a microcomputer for $99 which will attach to a home television set. However, like all computer systems, the greater costs are associated with computer peripherals (printers, disk drives, etc.) and software (including coureware). The cost of a computer system varies significantly based on functional use (administration, instruction), capacity (memory), configuration (peripherals, communications) and quantity acquired. The guaranteed large quantity purchases in Region 4 ESC resulted in discounts up to 33 percent.

The following table reflects recent data regarding percent microcomputer prices. These are approximate figures and reflect up to 22 percent discounts. State-supported colleges and universities have cooperatively contracted with IBM to acquire up to 2,000 microcomputer systems over a two year period for a 25 percent discount. The typical configuration in the table is a CPU with a 48K byte memory, a black and white TV monitor, and one disk drive. Exceptions in marketing configurations are noted.

MODEL	MEMORY	CPU w/ MEMORY	B/W MONITOR	DISK DRIVE
IBM 5150 Model 14	64K	$1,500	$293	$383
Apple II Plus	48K	910	75	425
Commordore PET	32K	950	including TV	514
TRS80 III	48K	886	including TV	623
Atari 800	48K	940	95	510
TI 99/4A	48K	725	340 (color only)	550

Other significant costs for typical instructional capabilities and services include:

- Maintenance $150/year/system
- Communications CPU attachment . . . . $170 per CPU
- Acoustical coupler . . . . $200 per CPU
- Graphics table and CPU attachment . . . . $625 per CPU
- BASIC Language CPU attachment . . . . $155 per CPU
- VisiCalc (business analysis) software . . . . $199 each
- SuperScriptSit (word processing) software . . . . $199 each
- Miliken Math K-8 series diskettes . . . . $450 per set

Control Data Corporation now offers a MicroPLATO system with a single disk drive and a touch-sensitive TV screen. Some instructional courseware in reading and mathematics is also available for grades 3-12. Vocational education courseware is also available. Each MicroPLATO system costs about $7,950 per unit and courseware package costs vary up to $900. The very good PLATO courseware will soon be available on other less expensive microcomputers.

Networked microcomputer systems (many micros sharing a hard disk drive, a common printer and a master micro for the teacher) with up to 63 slave microcomputers attached provide another option. Such a networked system with a 6 megabyte hard disk, an 80 character printer and all other necessary hardware and software (excluding the 64 computers) would cost $36,275

Several education service centers have Hewlett Packard minicomputers (HP2000) which provide some dialup time shared instructional services. The cost to schools for these instructional services is approximately $2,500/year per port access to the computer. This includes CPU usage, all instructional courseware available on the HP2000, workshops, onsite visits and other interface services. The terminal and acoustical coupler needed can be leased from the ESC at $150/year. Maintenance for those terminals would cost the school an additional $240/year. Communication costs would also be additional and can run as high as $1500/ year depending on distance and

The computers used at the eight regional processing centers in the statewide system of computer services range from very large (Amdahl 470/V7B at Region 20 ESC) to medium (Data Point ARC at Region 17). These computers are used primarily for administrative purposes and the original costs for CPU and memory only vary from $1.2 million to $90,000. School districts pay for administrative services received which provides most of the revenue to amortize the cost of the equipment and to support personnel and other resources necessary to operate these systems. The state provides a small subsidy (TEC 11.33(b)) distributed through education service centers, to encourage school districts to use the statewide system of computer services. This yearly computer services subsidy is authorized at $1/Average Daily Attendance (ADA) and amounted to $2.6 million in 1981-82.

Communications expenses can be significant as well where networked time shared systems are used. Mission ISD has a centrally networked instructional system using two Data General Nova 3 (at $50,000 each) computers to support five elementary campus laboratories consisting of a total of 177 terminals. Local communications costs for this totally instructional system are approximately $18,000 a year. This system is over five years old and has statistically demonstrated significant improvement in student performance on the California Achievement Tests. Communications costs can also be significant for remote (long distance telephone rates) school districts acquiring administrative services from the eight regional processing centers. To make these services more equally accessible in terms of cost, the Texas Education Agency provides a communications subsidy out of the state computer services allotment noted above ($140,000 in 1981-82).

Conclusions

The foregoing examples of technology systems are not futuristic. Schools can profitably use technology if resources and planning are provided. Some schools have moved into use of these technologies on their own initiative and they should be encouraged and assisted to continue. Central planning and development should begin to realize the opportunities available in technology in order that planned growth and equity of opportunity can be assured within the state public school system.

With telecommunications systems and devices, as with computer and other technology, certain needs arise which must be addressed if the technology is to be adopted and used by educators. The massive use of present and yet-to-come technologies in society does not automatically mean schools can or will use them. Caution as well as courage is needed. Comprehensive planning and start-ups unrestricted by some of the handicaps of traditional budgeting patterns and school management will be necessary if schools are to remain competitive in the use of technology for education.

A beginning approach would be to authorize and fund a sub-system within the school system to plan, develop and implement technology projects to eventually serve all. Such a system has the advantage of being task oriented, large enough to affect critical mass, strong enough to standardize some elements so productivity can begin, or viable enough so that consistency is present over fairly long periods. The public school system is for the public good. It may be thought of as a way that society guarantees equity for its youth, including access to information. Access to information is power—the schools cannot set a backward example in the use of information technology by allowing only the rich who can afford it, to use it.

Texas likely has the wealthiest school system in the nation. The state is a leader in electronic technology industries. No state is better posed to embrace the information age—the technology era. There are many avenues to excellence. Students not prepared to use the technology of the next decade will not have excellence. Those students can be prepared for technology in two major ways: by using the technology as they learn and by seeing the technology being appropriately used. The mere acquisition of computer or television devices is no more meaningful to the untrained than is a pencil to a monkey. Technology is device dependent; students must have access to its devices, training in its uses, and must use it, if true learning is to occur.

However, it is wise to refine available technology, as well as to embrace new developments if productivity is to increase. A piecemeal approach, exemplified by a rush to get computers in the classroom, and knee-jerk reactions are little better than ignoring technology. Possibly the most difficult situation presented by present technologic events is that there is little time to absorb, even diffuse, its impact. Technology is pervading the larger society too fast. Education, if it remains neutral, may be bypassed. The opportunity is not in resistance, but in acceptance. The advantages of technology itself promote society's acceptance and support. Faster, more powerful and less expensive than alternative ways, technology may allow education to use it defensively, for example to reach more students with individual, effective and consistent teaching in basic skills, to offset teacher shortages in critical areas, to provide superior library services to students, to cut teacher time spent on record keeping and grading, or to offset new facilities costs.

The inevitable decrease in the purchasing power of schools this decade will force a very careful examination of public school expenditures in terms of cost effectiveness and maintenance of the scope and quality of programs presently being offered. Technology not only can be utilized to maintain present status, but it promises to expand the ability of public schools to deliver varied, creative and multi-leveled instruction to diverse populations throughout the state. Never before has such a possibility been within reach. Perhaps the most important promise of technology has to do with its potential to broaden the horizons of the learning process itself. Learning plateaus to which students can aspire will no longer be limited by the availability of appropriate teachers or facilities. The challenge is to society as well as to educators and legislators. The challenge is to the imagination, to grasp the opportunities available in technology. The challenge will be to treat technology as an important element in schooling rather than as a supplemental, peripheral, separate issue.

Recommendations

Curriculum Recommendations

Recommendation #1:

It is recommended that the Central Education Agency emphasize the importance of science, mathematics, and technology education by:

- incorporating specific course content objectives within existing requirements for high school graduation; and

- considering increasing the high school graduation requirements for mathematics and science if found appropriate.

Justification

Maintenance of United States leadership in science and technology, and support of a commitment to the democratic ideal of full and informed citizen participation, require an educational system with capacity not only to generate a sufficiently large pool of well-prepared students to pursue professional science and engineering careers but also to raise general science and technology literacy levels for all students in order to prepare them to live in a technological society.

Research collected by the National Science Board shows that high school students today are shunning science and taking the minimum of math. Mathematical and verbal Scholastic Aptitude Test (SAT) scores have declined steadily over an 18-year period through 1980. The decline of mathematics scores among 17-year-olds is particularly severe in the areas of problem solving and applications of mathematics. Yet these are the very skills that are necessary to produce students who can relate to technologically oriented tools such as computers. These are the adults who will live their lives in the age of technology and electronics. Already employers in industry and officers of the military complain that new recruits cannot function in work that requires technical or logical understanding.

Such issues and documentation point out the importance of not only educating young people in the arena of computer literacy but also assuring that they develop the solid foundations in science and mathematics to enable them to enter the world of technology. The National Governor's Association Task Force on Technological Innovation in February of 1982 issued a "Resolution of Technological Excellence" which says that "States and federal government should join together with business, labor and academic leaders to demand excellence and substantially higher levels of achievement in math, science, engineering and computer learning in our schools."

Recommendation #2:

It is recommended that the Central Education Agency make provisions to encourage access to computer literacy for all children in Texas by:

- developing standard minimal objectives for computer literacy as an integrated part of existing curriculum at the primary and secondary level;

- providing for optional courses at the secondary level for students wishing to further pursue various studies in computing science, business automation, or vocational education.

Justification

The need for computer literacy is just being realized by people in general. Some of the basic issues involve what students should learn about computers, when they should begin to learn, and the ways they should learn about or use them. When a computer interacts with a student in a computer assisted learning mode, the student need not know much about computers. However, even this elementary interaction creates in the student a desire to learn something about the device. When a student interacts with a computer, developing programs and solving a variety of problems, more knowledge of computers is required—on both the part of the student and the teacher.

It is important that students understand the rapid changes that are occurring in the computer field and how the future of automation will affect their lives (privacy, computer crime, etc.). In particular, how will computers affect the job market and the types of jobs that are available? Current estimates are that computer-based automation of manufacturing in the United States will eliminate ten million jobs over the next twenty years. The office of the future will utilize word processing, computerized information retrieval and electronic mail. Knowledge and skills needed to function in the automated environment of the future are different from the knowledge and skills that most students are acquiring in today's schools.

A student who understands these potential changes will be prepared to successfully function in such a society. Student decisions on education and career goals should take into consideration how computers are changing the world. An understanding of these changes is an important part of computer literacy.

Professional Personnel Development Recommendations

Recommendation #3:

It is recommended that the State Board of Education:

- request the Commission on Standards to review teacher certification requirements in order to assure that computer literacy standards, both for using technology in schools or for teaching various levels of computer literacy, are included in the teacher training process. This should be done in such a way as to recognize concerns of need balanced against the issue of over-specialization; and

- establish a coordinated program for effective teacher in-service in cooperation with Regional Education Service Centers by utilizing staffs of ESCs, school districts, institutes of higher education and private resources.

Justification

In order to meet the challenge of teaching present and emerging generations of students how to function in a technologically oriented world, it is imperative that teachers and administrators be trained immediately to understand the uses of a computer, how to use a computer in instruction and how to teach about a computer.

One of the reasons teachers and administrators have been slow to learn about computers is fear of the unknown, fear of replacement, fear that is a combination of "math anxiety" and the assumption that computer work lies primarily within the area of mathematics teachers. Teachers and administrators can reduce and eliminate these fears by learning more about microcomputers and having hands-on experience with them. The microcomputer itself will help because the equipment resembles a cross between a typewriter and a television, and in that sense it is somewhat familiar and comfortable.

Given the present shortage of teachers, particularly in the area of mathematics and science, it becomes a critical issue to consider how sufficient numbers of computer literate as well as computer science teachers will be recruited to step into the teaching ranks. Serious coordinated planning, the development of short- and long-range goals, and the expanded allocation of resources for massive computer literacy training will be needed in order to meet this challenge.

If districts choose to implement computer programs with existing staff, then certain job descriptions will have to be changed so that it is very clear whose responsibility it is to keep up with the state-of-the art, to find and catalogue needed courseware, and to maintain the equipment. For example, centralized computer assistance is a function that could be most economically provided by Education Service Centers. They already possess transportation for the delivery and pick-up of media. Vendors of computer equipment would have only one contract to deal with and the administrative burden would be removed from the schools.

Clearly the need for trained staff is great at all levels: general computer awareness, varying degrees of computer literacy and knowledgeable administrative support for implementation of technology in education.

Funding Recommendations

Recommendation #4:

It is recommended that the Legislature support coordinated efforts to encourage technology in education by increasing monies flowing to Regional Education Service Centers through TEC Section 11.33 (a) & (b) in order to:

- provide priority funding for inservice programs for mathematics, science and computer science teachers; and

- provide incentive funding to encourage district acquisition of hardware and software.

Justification

The 20 Regional Education Service Centers provide guidance and training to local school districts in the area of computer technology. They also provide a statewide system of computer services for school manangement. Participation of school districts in these regional computer services has grown steadily since the early 1970s. Basic services include: student master files, class scheduling, test scoring, grade and attendance reporting, payroll services, personnel accounting, financial accounting, and ad valorem tax accounting. School district participation in the services is voluntary.

Regional Education Service Centers also provide a variety of other regional computer services. These services are optional and are not eligible for the state support allotment. Optional services include inventory control and systems for bus maintenance, bus routing and textbook accounting. State-of-the-art capabilities such as distributed processing and on-line file update and inquiry are also being used by an increasing number of districts. While the services being provided to the districts appear to be very useful and appropriate, many districts do not have sufficient funds for participation in the services.

Recommendation #5:

It is recommended that the Central Education Agency prepare to establish funding priorities for support of technology in education in the next biennium by:

- carefully documenting information gathered through Recommendation 4;

- establishing a coordinated data base covering locations, applications, and effects of technology in education; and

- using this information to support funding recommendations for the 1985-86 biennial budget request.

Justification

Funding for educational technology may flow simultaneously in several directions. Funding sources may be categorical as for books, television, media or computers, going into library programs, vocational units, language arts or science programs, and into special programs for migrant or special education. All these educational programs are technology users and directly or subliminally teach certain technologic user skills.

There is a lack of an adequately large and focused funding for educational technology within the public schools to allow statewide planning, development and implementation of programs for technology. School managers are inexperienced with treating technology as comprehensive systems or with refocusing a variety of funds onto technology uses and related skills.

Technology in education must be coordinated, infused with already existing content areas so that all will learn to use technology appropriately within their respective disciplines.

A piecemeal approach is hardly better than ignoring the technology. Processes, criteria and training for review and selection of computer courseware must be established. This can only be done through a coordinated data base which currently does not exist.

Recommendation #6:

It is recommended that the Central Education Agency assume a leadership role in establishing both long and short range policies and plans on the coordination, use and implementation of technology in education by:

- developing a statewide data base concerning expanding adoption and nature of local district efforts in technological areas to be used for future planning;
- coordinating and disseminating information from school districts and Regional Education Service Centers to monitor technology in education in terms of hardware, courseware, courses offered and teacher training;
- developing policies relating to statewide utilization, coordination and compatibility of computer systems;
- interfacing with national and state organizations in technology-related activities of mutual benefit;
- fostering business-school partnerships for pre-college scientific and technological endeavors;
- identify and disseminate strategies for computer utilization in schools with less than 1,500 ADA, with further emphasis on small town and rural settings.

Justification

In spite of local efforts at coordination, the rapid proliferation of technology in education has continued in a sporadic way. Limited attempts at data gathering and projecting needs have only pointed out the need for coordination and the establishment of a focal point for information gathering and dissemination. Once there is an established format for planning, steps can be taken to move forward with funding recommendations which will:

(1) support long-range goals for the state,

(2) respond to levels of usage and awareness throughout the state, and

(3) be realistic in terms of the state of the art in terms of hardware and software.

Recommendation #7:

Responsibility for coordination of effort should be vested in one person in the Central Education Agency, creating a leadership position to administer a division of technology in education.

The position should be interdisciplinary regarding curriculum, teacher training, evaluation, and emerging technology, and should be responsible for development, procurement and validation of hardware and software.

Justification

In order to accomplish Recommendations 1 through 6, it appears to be necessary to establish a focal point at the state level to act as a catalyst. The subcommittee believes the creation of a division of technology within the Central Education Agency could fulfill this role.

Appendix A

Glossary

Access Time:
The time required to gain access to needed data. A modern computer can access data from storage very quickly. Examples: from primary storage—less than 1 microsecond; magnetic disk—25-100 milliseconds; magnetic tape—50 milliseconds to several minutes. Generally speaking the shorter the access time, the more costly the storage system.

Accumulator (AC):
An area of circuitry contained in the CPU for temporarily storing data words accessed out of memory, arithmetic and logical operands, and results of CPU operations.

Address:
The location of a particular bit of information in a main or auxiliary memory system.

ALGOL:
A computer language designed mainly for programming scientific applications. This is one of the more modern and widely used procedure-level languages.

Algorithm:
A finite, step-by-step set of directions guaranteed to solve a particular type of problem. Computers can sometimes carry out some of these steps. Examples are long division, square roots, or others that are studied in mathematics courses. One of the two general categories of procedures studied in computer science. (See *Heuristic*)

Alphanumeric:
A term describing information that consists of both letters and numbers.

Analog Computer:
Electronic circuitry that measures and manipulates information in the form of fluctuations and variations of electricity. Measures physical or electrical variables rather than numerical variables.

AND:
A Boolean logic operator.

Application Program:
The software for a computer program may be classified as application programs and systems programs. An application program is designed to solve a certain type or class of problems. For example, one might have an application program designed to solve a certain type of equation, or to perform a specific statistical computation.

Arithmetic-logic Unit:
The portion of the hardware of a computer in which arithmetic and logical operations are performed. One can think of it as a superspeed electronic calculating device. The central processing unit of a computer consists of an arithmetic unit and a control unit.

Artificial Intelligence:
The mode of programming which allows a computer to operate on its own, for example to learn, adapt, reason, or correct and improve itself.

ADCII:
American Standard Code for Information Exchange. An eight-level code for data transfer.

Assembler:
A computer program that takes instructions written in assembly language and converts the instructions into a specific machine language. Many assembly language statements such as ADD and SUB translate directly into single machine language instructions.

Assembly Language:
A computer language intermediate between machine language and compiler languages. It allows machine language in- structions to be written in simplified form using mnemonics and other standardized abbreviations.

BASIC:
Beginner's All-Purpose Symbolic Instruction Code. A procedure-level computer language that is well suited for timeshared computing. It is a relatively simple, high level language which is widely used in schools.

Baud:
Signifies the measure of serial data transmission in bits per second.

Binary:
A number system based on powers of 2, and having only two digits: 0 and 1. Operations inside the computer are in binary form (current through a particular circuit is either on or off). Decimal 178 is represented in the computer as binary 10110010. Most computers are based on the binary system.

Binary-Coded Decimal (BCD):
A mode of representing decimal numbers in patterns of 1s and 0s.

Binary Data:
Data which is written in binary, octal, or hexadecimal form and which can indicate various codes to be used for computer operation.

Binary Digit: (See *Bit.*)

Bit:
A coined word from Binary digit; this is one of the whole numbers, 0 or 1, which will indicate by on/off signal to the computer what it is to do.

Bootstrap Loader:
A technique or device used to lead a routine into computer memory.

Branch (jump):
A means of departing from the sequence of the main program to another routine or sequence of operations as indicated by a branch instruction whose execution is dependent on the conditions of the results of computer operations.

Bubble Memory:
Computer memory that does not forget what it knows, even when the power is shut off. Bubble memory is mid-way in price and speed between PROM and floppy disk.

Bug:
An error in program or defect in computer hardware causing a malfunction in computer operations.

Bus:
A circuit path over which data and/or instructions are transferred throughout the computer. Buses allow for the transmission of information among memory, CPU, and I/O devices. Different bus lines have specific purposes: e.g., data bus, address bus, control bus, etc. S-100 Bus is becoming an industry standard—it means there are 100 connections to circuits.

Byte:
One 8-bit computer word. Byte is also interchangeably used in microcomputers to mean one character (a letter, number of symbol) of information. Thus 8K bytes of memory means a capacity of approximately 8,000 letters or numbers of data that can be remembered by the computer. One byte is equivalent to one keyboard keystroke. Widely used as a measure of computer capacity.

CAI:
Computer Assisted Instruction. A method of using a computer system as a means of presenting individualized instruction materials. In CAI the computer is used as an instructional delivery device.

Cathode Ray Tube (CRT):
The type of vacuum tube used as the picture tube in a TV set, and as the display screen in many computer terminals.

Central Processing Unit:
The group of components of computer system that contains the arithmetic-logic unit and the control unit (control circuitry). This part of the computer is responsible for interpreting data and executing instructions.

Character:
A letter, digit, punctuation mark, or other sign used in the representation of information. Computers are designed for the input, storage, manipulation, and output of characters.

Chip:
A small piece of silicon with electrical circuits imprinted on it. In computers, this is usually a microprocessor, containing both CPU and main memory system. (See *Integrated Circuit.*)

Clock:
A device that initiates pulses for the synchronization of computer operations.

COBOL (Common Business Oriented Language):
A high level language heavily oriented to the use of files and record keeping. It replaces operation codes of assembly level languages with a set of powerful "verbs" resembling common English.

Compatibility:
The ability of one device to accept and handle data that have been prepared or processed by another device without data conversion or computer program modification.

Compiler:
A computer program (that is, software) that translates a program written in a procedure-oriented language such as BASIC, COBOL, or FORTRAN into a machine language or an assembler language.

Compiler Language:
A language such as BASIC, COBOL, or FORTRAN designed to assist the programmer in writing procedures to solve problems. A single statement in a compiler language usually translates into a sequence of machine language statements. Also called a procedure- level language.

Computer:
A device that can input, store, manipulate, and output data. It can automatically follow a program (a detailed step-by-step of directions). Two major categories are Analog Computer and Digital Computer.

Control Unit (CU):
The hardware contained in the CPU which controls the sequencing of operations, interpretation of codes, and the allocation of signals to their proper place.

Core Storage:
The primary or internal memory of a computer. The word comes from the very small doughnut-shaped iron cores which at one time, were the most widely used form of primary storage. Now, solid-state devices are often used as primary storage—but may still be mistakenly called core memory.

CPU: (See *Central Processing Unit*).

Cross Assembler:
A program that works in one kind of computer to translate source programs into object programs to be loaded into another kind of computer.

CRT: (See *Cathode Ray Tube*).

Data:
The information (or set of signals) that is processed by a computer.

Data Bank:
A comprehensive collection of data.

Data Processing:
The computer activity of receiving information, operating on it, and producing a desired result.

Debug:
To find and correct a malfunction in computer operation or in a program.

Digital Computer:
A kind of computer that uses characters (digits, letters, punctuation marks) to represent data and programs, a digital computer can be thought of as an automated character manipulation machine.

Direct Access: (See *Random Access*).

Disk (Disc):
A circular piece of material which has a magnetic coating similar to that found on ordinary recording tape. Digital information can be stored magnetically on disk, much as musical information is stored on a magnetic tape.

Documentation:
Materials designed to help a user to understand and use a program. Includes stepwise refinements, flowcharts, program listings containing adequate numbers of REM statements, sample computer output, written directions and descriptions, etc.

DOS (Disk Operating System):
A computer system which uses disk storage. Also refers to special software routines for driving a disk system.

Driver:
A control unit for peripheral device; e.g., a floppy disc drive.

Drum:
A rapidly rotating cylinder, the surface of which is coated with a magnetic material on which information is stored in the form of small magnetized spots. It is an example of a direct access storage medium.

EBCDIC:
Extended Binary Coded Decimal Interchange Code.

Editor:
A program used in the preparation of text material for assembly-language source programs.

EROM (Erasable Read Only Memory):
A ROM which can be erased and reprogrammed. The typical contemporary EROM is erased by exposure to ionizing radiation such as ultraviolet light.

Execute:
In machine operation, to interpret instructions and carry out designated operations.

Feedback (loop):
The information which is output to a system to inform it of its present condition so that the desired activity of the system is reached; e.g., a themostat.

File:
A collection of related records treated as a unit. A file is often classified as a program file (a computer program) or a data file (a collection of records to be processed by a program).

Firmware:
Programming built into the computer to make its operation simpler for the user to understand. Firmware is usually supplied by the manufacturer stored in PROM memory units. See *Monitor.*

Floppy Disk:
A soft disk coated with electronic recording material, used as an auxiliary memory system. A small floppy disk is called a ''minifloppy''.

Flowchart:
A diagram used to plot information and the order in which it should be processed (represents program logic). Used to develop programs.

FORTRAN (FORmula TRANslation):
A computer language useful in computational programming.

Hardware:
The physical equipment which makes up a computer system.

Heuristic:
A finite step-by-step set of directions designed to solve a certain type of problem. It may incorporate rules of thumb, methods of guessing, or trial and error in an attempt to come up with a solution. But there is no guarantee (proof) that a solution will be obtained. Methods for attacking general problems (what do you do when faced by a new problem situation?) are usually heuristic procedures. Many of the programs used in the field of artificial intelligence are heuristic programs.

Hexadecimal:
A number system based on powers of 16, and having sixteen digits usually numbered 0 through 9 and A through F. Decimal 178 is represented as B2 in hexadecimal notations. Note that a 8-bit byte can be expressed in two hexadecimal digits, or in eight binary digits.

High-Level Language:
A problem oriented computer programming language— e.g., FORTRAN, APL, and COBOL—which requires the use of a compiler program before any program written in the language can be understood.

Hz:
Hertz, the frequency of a wave in cycles per second.

IC: (See *Integrated Circuit*).

Input:
Information given to a computer for processing from outside the computer system.

Input Device:
Hardware used for putting data into a computer for processing; e.g., a keyboard.

Input/Output (I/O):
The hardware used to enter data into and produce data from a computer system.

I/O: (See *Input/Output*).

Instruction Set:
The repertoire of the instructions a given machine can execute. A major component of a computer's design. The programs of one computer can't run on another computer if the two instruction sets are not compatible.

Integrated Circuit (IC):
A technique whereby many electronic components can be integrated and mass produced on a single chip of silicon.

Interface:
(1) the point of contact (a circuit) between different systems or parts of the same system; (2) to connect two systems or system components in order to facilitate their interoperation.

Interpreter:
A language program translator that recondenses each user-created high-level language instruction into executable binary each time it encounters a user instruction. Interpreters are therefore inefficient and slow translators, but they do permit the user to rapidly modify his program in conversational dialogue with the interpreter.

K:
A symbol used to denote a little over a thousand of something. "8K bytes of memory" means the same as "about 8,000 memory cells." One K equals exactly 1,024. Typically, an 8-bit microprocessor is capable of addressing 64K memory cells.

Keyboard Terminal:
A computer input and output device with a type-writer-like keyboard and a display mechanism (paper or CRT).

Language:
A set of computer words and syntax used in giving the computer a set of instructions to perform. Some common computer languages are BASIC, COBOL, FORTRAN, ALGOL.

Large Scale Integrated Circuit (LSI):
A circuit consisting of many hundreds or thousands of transistors and other electrical components, and manufactured as a single unit. See *Chip*.

LED:
Light-Emitting Diode. LED displays are often used as digital output devices because of their low weight, cost and size.

Light Pen:
A pen-shaped device for direct input to a computer by passing the pen over data to be transmitted, also sometimes called a light pencil or a wand reader.

Line Printer:
A high speed printer connected to a computer can print data at rates often exceeding several hundred lines per minute (LPM). This is achieved by printing a whole line at a time.

LISP:
A very sophisticated and theoretically oriented language for doing list processing.

LOGO:
A computer language designed to give all beginners, including young school children, the ability to program computers. Users learn a new audio visual realm where they can explore, experience, discover, and learn the fundamentals of geometry, mathematics, and text manipulation through a creative, problem-solving process.

Looping:
A programming technique used to repeat a single portion of a program. The repetition may continue indefinitely (an indefinite loop) or until some predetermined condition is satisfied (a conditional, or finite loop).

Machine Language:
The lowest level of programming. This is the only language the computer can understand without the assistance of an assembler, compiler or interpreter.

Magnetic Core:
A data storage device based on the use of a highly magnetic, small, doughnut-shaped piece of iron capable of assuming two discrete states of magnetization. See *Core Storage*.

Magnetic Disk: (See *Disk*).

Magnetic Tape:
The magnetic tape used for secondary storage on a computer system. It is much like that used on a home tape recorder, although it often is of higher quality. Recording densities of 800, 1600, or 6250 characters per inch are common. Thus a large reel of tape can store many millions of characters of information.

Mainframe:
The main elements of a computer system, usually the CPU and main memory systems.

Megabyte:
A million keystrokes; a million characters.

Memory:
A circuit that stores information in specified locations (called addresses) where the computer can retrieve it as needed. Most computers have a primary memory with very fast access which is relatively small, and a secondary storage which can contain a large number of characters of information, but has slower access time.

MHz:
Megahertz; a unit of frequency equal to one million hertz (a hertz equals one cycle per second).

Microcomputer:
Hardware composed of a group of separate elements including read-only memory and random-access memory, microprocessor, interface logic for I/O, timing circuitry, and circuitry for transmitting signals from one element to another.

Microprocessor:
A very small silicon chip imprinted with the circuitry for a complete CPU and main memory system, which can be used in a microcomputer. A single integrated circuit (IC) chip.

Microsecond:
One-millionth of a second. A modern computer can access information in its primary memory, or add two numbers, in less than one microsecond.

Millisecond:
One-thousandth of a second. Useful in discussing speeds of computer peripherals such as input-output devices and secondary storage. The access time for a disk might be 25 to 100 milliseconds.

Modem (Modulator-Demodulator):
Converts audio sounds into digital form, and vise versa.

Modulator:
A device that lets a computer use any ordinary television set for output. This term is understood in this sense mainly with respect to personal computers as such modulators are not generally used with larger machines. It is sometimes referred to as an RF modulator. RF stands for Radio Frequency, meaning television broadcasting.

Monitor:
A small package of software usually stored on PROMs that gives the computer a fundamental interactive intelligence. The Monitor usually contains software routines and I/O drivers needed by the user to operate the system. The Monitor is a kind of executive secretary for the user. It tells the computer how and where to acquire the programs and data; where to store them, and how to run them.

Motherboard:
The central communications bus line. The spinal cord of a microcomputer.

Nanosecond:
One thousandth-millionth (that is, a billionth) of a second.

NAND:
A Boolean logic operator combining NOT and AND.

NOR:
A Boolean logic operator combining logical operations NOT and OR.

NOT:
A Boolean logic operator specifying negation.

Object Program:
The machine-language program which can be loaded into computer; a result of assembler or compiler program execution on an assembly-language or high-level-language source program.

Octal:
The basic 8 number system. It is commonly used when programming in machine language ("375" is easier to remember than "011111101")

Opcode (Operation CODE):
A bit pattern which specifies a machine operation to a computer's central processor. Often listed in hexadecimal or octal notation.

Operating System:
A sophisticated monitor often found with floppy disc systems.

Optical Character Recognition:
The machine reading of typewritten or handwritten characters. The typewritten or carefully hand-written materials are now commonly read by computers, but computer reading of general human handwriting is still a research problem.

OR:
A Boolean logic operator.

Output:
The results of computer operations on input.

Output Devices:
The hardware that receives processed input signals and puts them into a form understandable to computer user; e.g., a line printer.

Parallel:
A type of interface in which all bits of data in a given byte are transferred simultaneously, using a separate data line for each bit.

PASCAL:
Philips Automated Sequence Calculator—a language designed to enable teaching of programming as a systematic discipline and to do systems programming.

Peripherals:
External devices connected to the main computer CPU and memory systems. Examples of peripheral devices are magnetic tape units, disk loaders, line printers, and other input/output devices.

PILOT:
A simple language for preparing computer-assisted instruction courses. Various versions have been written in BASIC, APL/360, and SNOBOL, and some have different names.

PL/1:
Programming Language 1—a computer language designed for programming both scientific and commercial applications. One of the more modern compiler languages.

Primary Storage:
The fast-access part of a computer's memory system. It operates at a speed comparable to the arithmetic and logic unit. It is generally much smaller in storage capacity than the secondary storage part of the memory system.

Program:
A set of instructions which instruct the computer to do a certain task.

Programmable Read Only Memory: (See *PROM*).

PROM:
Programmable Read Only Memory. This is computer memory which does not forget what it knows, even when the power is shut off. Some kinds of PROMs can be erased and reused; EPROMs, or Erasable PROMs. PROMs are a convenient way for the user to design his own operating system software and other tailor-made monitor routines.

RAM (Random Access Memory):
The main memory or storage device. Information can be written into and read out of this memory and can be changed at any time by a new write operation. The contents are usually lost when the power is shut off.

Random Access:
Access to data storage in which the position from which information is to be obtained is not dependent on the location of the previous information, as on magnetic drums, disks, or cores. The time required to access a piece of information is nearly constant (nearly independent of the location of the information). Also called direct access.

Random Access Memory: (See *RAM*).

Read Only Memory: (See *ROM*).

Real Time:
A computer system operating immediately as data is input, with the CPU immediately replying to the user via output lines.

Record:
A group of related pieces of computerized information. For example, a student's transcript might be one record, and the collection of all transcripts for a school might be one file.

Response Time:
The elapsed time between the completion of an input message at a terminal and the display of the first character of the response.

ROM:
Read Only Memory. Non-erasable, permanently programmed memory usually used to store monitors and I/O drivers needed whenever the computer is used. Programs stored in ROM are called Firmware and cannot be modified by the user.

RS232:
An industry-wide standard protocol for serial communication between computers and peripheral devices.

Secondary Storage:
A peripheral storage device that can store information in a form acceptable to the computer, such as on magnetic tape, disk, or drum. It is also called bulk or auxiliary storage, and its cost per character of storage is usually considerably less than for primary storage.

Sequential Access:
A process which consists of reading or writing data serially, and by extension, a data-recording medium that must be read serially. Magnetic tape is a sequential access storage medium.

Serial IO:
A method of transmission in which bits are sent one by one.

Simulation:
A computer program which models some system, typically using mathematical techniques.

Software:
Generally used for computer programs, but also used to refer to everything that is not equipment (hardware).

Source Program:
The original program that is written in assembly or high-level language and is translated into a machine-language object program for use in the computer by an assembler or compiler program (respectively).

String:
A group of data elements (usually ASCII characters) stored in sequential memory locations and treated as one unit for I/O operations, text editing and other program manipulations.

Subroutine:
A subprogram within a larger program.

System:
An assembly of components united by some form of regulated interaction to form an organized whole. A computer is a system consisting of hardware and software.

Terminal:
An input/output device linked directly to the computer by data lines. A device for communicating with a computer using a keyboard and an alphanumeric printer or cathode-ray tube (CRT) display.

Time-Sharing:
A means by which one or more terminals can be connected to and work with one central computer system.

Translator:
A computer program which translates from a high-level language such as BASIC into a lower-level language such as a machine language.

TTY:
Abbreviation for a teletypewriter keyboard terminal. This is the most widely used of all general-purpose keyboard terminals.

Turn-Key:
A computer system ready to perform all tasks the moment you turn it on. Business and accounting software is frequently supplied in ready-to-run form on such a system.

UART (Universal Asynchronous Receiver Transmitter):
Converts parallel data into serial form, or vice versa.

Users' Group:
An association of people who all have an interest in a particular computer or group of computers. They usually meet to exchange information, share programs and accomplishments, and trade equipment.

Word (Memory or Computer):
The smallest unit of information dealt with by a computer. Words can specify data or instructions.

Word Length:
The number of bits contained in a computer or memory word. The size of word length determines the flexibility and accuracy of the computer.

Appendix B

Case Studies

Many site visits were made by Subcommittee members, advisers and staff to school districts, consortiums and broadcasting studios in Texas to examine the different aspects of technology utilized.

The case studies that follow describe the site visits and illustrate the demographic data, the programs utilized, strengths and weaknesses of such programs, and future plans.

North Oaks Elementary, Round Rock, Texas

Demographic Data

Round Rock Independent School District #236-909
1311 Round Rock Avenue, Round Rock, Texas 78664 Williamson County 108 Square Miles
Student Population: 11,256
Ethnic Make-Up: 239 Black, 1,099 Hispanic, 9,749 White, 169 Other
Number of Campuses: 2 high schools, 3 junior high, 11 elementary
Market Value of Taxable Property: $1,249,500,00
Current Tax Rate: $.90 of which $.30 is for debt service

North Oaks Elementary is located in the Round Rock Independent School District. The student population of North Oaks is 618. The ethnic make-up of the school is 560 white, 18 black, 25 hispanic, and 15 other.

Uniqueness of Program

A unique aspect of the program at North Oaks Elementary concerns the flexibility of the program. All levels of students—from special education to gifted and talented students—are actively participating. The PTA has assisted the school in purchasing computer systems.

Description of the Program

The program has been in progress for only one year. Grades K-5 and self-contained special education classrooms have access to the computers. Drill and practice and tutorial instruction are administered in grades K-3. Programming skills in BASIC and LOGO are introduced in 4th and 5th grades. The computer systems are on portable carts, and are used in the centrally located library as well as in individual classrooms.

MECC, Texas Instruments, and Scott Foresman software are utilized in the program.

Identified Strengths and Weaknesses

1. Every teacher has now had some kind of exposure to the use of computer in instruction.
2. Community support for the instructional program appears strong.
3. Relatively high costs for hardware, coupled with limited funds, creates the major limitations of the program.

Future Plans

Future plans call for expansion of the computer systems, including an increased level of staff development for North Oaks instructional staff. Additional computers will be purchased, and budgeted amounts for software will be increased.

Skyline Career Development Center, Dallas, Texas

Demographic Data

Dallas Independent School District—#057-905
3700 Ross Avenue, Dallas, 75204 Dallas County 351 square miles
Student Population: 134,074
Ethnic Make-up: 49% black, 21% hispanic, 30% white and other
Number of Campuses: 217—137 elementary, 20 middle, 20 high, 6 magnet, 7 alternative, 5 service centers, 4 administrative facilities, 15 other

Market Value of Taxable Property: $21,559,227,941
Current Tax Rate: $.80, of which $.08 is for Debt Service
Outstanding Debt: $133,828,150

Skyline Career Development Center (SCDC) is part of the Dallas Independent School District. Student population at Skyline is 3947 with an ethnic makeup of 55% black, 10% hispanic and 35% other. The campus is located on 80 acres, and the building complex covers approximately 14 acres under roof.

Uniqueness of Program

The planning for Skyline Center began in 1965. The Texas Education Agency, the Dallas Chamber of Commerce, and representatives of many industries joined with the district in the development stage and provided input. Career Education was desigated as one of the seven priority goals of the district. To help fill this need, Skyline Center's planning, preparation, and design have focused on this area. Skyline Career Development Center's 24 areas of study and its original curriculum have made it the center for Career Education for the School District and the entire city of Dallas. Unique aspects of the Center include a complete color television studio with a network of 250 viewing stations, a computer center, a 30,000 square foot airplane hangar, an extensive media center, a 1,600 square foot greenhouse, and numerous other special purpose areas.

Description of the Program

Skyline Center embodies (1) regular comprehensive high school, (2) a Career Development Center that is an extension of all Dallas high schools, and (3) a Center for Community Services that is an extension of the adult continuing education program of the Dallas ISD.

Students may attend the center on a parttime basis to take daily three-hour blocks of career education programs or may transfer to the center full time by becoming a Skyline High School student.

Skyline offers the basic curriculum of other Dallas schools, has regular activities such as football and student government, and has set student assignment boundaries.

The Center for Community Services operates an extensive day and evening program at Skyline Center. This program includes both credit and non-credit courses and utilizes the modern facilities of the Center.

The administration and faculty of Skyline Center are committed to quality education—that education which will provide a basis for people to make their own way in society as responsible, contributing citizens.

All of the teachers are certified, and must fulfill the requirements of the Texas Education Agency by taking the required courses for certification. Career Development Center teachers have college degrees with three years experience, or five years experience in industry in the area in which they teach, and a high school diploma.

Each of the schools has a separate administrative staff, a principal for the High School, a manager for the

Career Development Center and a director for Adult Education. All work together in implementing the program and keeping students involved in all instructional programs.

The overall cost of building Skyline Center was $21 million, financed by a bond issue. The enrollement usually totals 4,000 students. Every year information teams go to the Middle Schools and High Schools and give information on programs available in Skyline Career Development Center and Magnet Schools.

Skyline Career Development Center represents a firm commitment by the Dallas ISD to provide students with education beyond the ordinary. The Center's programs are intended to enable each student to maintain a balance of academic and career education. The curriculum is designed to privde each Career Development Center student with (1) a high school diploma, (2) the preparation to enter college or technical school, and (3) career skills to be used for future employment or to put the student a step ahead in advanced education.

Skyline Career Development Center is organized into Career clusters. Each cluster encompasses several families of careers. These families are in turn made up of many specific career options. A student usually spends three hours daily working within a Career Cluster. His needs and his specific career interest help determine his individual course of study and how much time he spends on individual tasks.

Identified Strengths and Weaknesses

1. Professional instruction from full time staff and leading experts.
2. A curriculum designed especially for the center and unavailable in the regular high school.
3. In-depth exploration of specific career areas.
4. Career advisory committee of outstanding professionals.
5. Extensive field seminars.
6. Internships in area agencies, centers and schools.
7. Limitations with transportation for students imposed by geographic location.

Future Plans

There are no plans for expansion at Skyline Center. Skyline Center will be utilizing computer much more in the coming years, and will concentrate on improving the existing program.

Marsh Middle School, Dallas, Texas

Demographic Data

Dallas Independent School District—#057-905
3700 Ross Avenue, Dallas, 75204 Dallas County 351 square miles
Student Population: 134,074
Ehtnic Make-up: 49% black, 21% hispanic, 30% white and other
Number of Campuses: 217—137 elementary, 20 middle, 20 high, 6 magnet, 7 alternative, 5 service centers, 4 administrative facilities, 15 other

Market Value of Taxable Property: $21,559,227,941
Current Tax Rate: $.80, of which $.08 is Debt Serveice
Outstanding Debt: $133,828,150

Uniqueness of Program

The group approach technique with the computer is a unique feature of the computer instruction programs at the Marsh School. This approach has proven to be very cost effective and is resulting in peer interaction. The computer literacy training for teachers and parents at the school is an important element in the program. In many cases, the student teaches the parent, thus developing student self esteem as well as computer literacy for the parent.

Description of the Program

Marsh Middle School is made up of 7th and 8th grade students. CASETS (computer assisted Spanish English transmission sequence) which began in 1980-81 as a Title VII research project, is the basis for the computer instruction program. The third and final year of the program will be in 1983. Information gained through the research project will be disseminated to the district in 1984.

The materials currently being design tested are the results of numerous refinements. Computer programs already in use were modified to conform to CASETS format. At present, the lesson programs are developed for mass production in order that option benefits can be realized once the project is complete.

A total of 146 students were served by the CASETS project during the 1980-81 school year in two schools. An additional 370 students were projected to be served during the 1981-82 school year.

Parents, students, and teachers surveyed during the project year indicated a strong positive attitude toward the CASETS project and computer assisted instruction in general.

To teach English as a Second Language (ESL) with the materials included, cost $11.22 per student per year. There are 130 sessions and each session cost approximately 9¢.

Marsh Middle School applied for a competitive grant in order to develop and improve English language proficiency of LEP students to pay for this program. The use of computer assisted instruction in the program apparently made the program attractive to the grantor.

Identified Strengths and Weaknesses

(1) The program focuses on low achievers who have been historically underserved by programs.

(2) Basic skills shown to be most deficient by TABS testing are specifically addressed.

(3) The developmental research approach is utilized.

(4) The primary disadvantage appears to relate to the cost of the necessary equipment to conduct the program.

Future Plans

For the 1982-83 school year, CASETS is proposing to offer an authoring program to the teachers who are using the materials. This will allow them to input vocabulary which they need to develop, and allow the students to do drill and practice exercises.

Also during 1982-83, an alternative instructional approach for both social studies and ESL sessions will be tested. In 1982-83, CASETS will conduct further investigations into the cost-effectiveness and time-effectiveness of the program.

Regional Instructional Television Consortium
Richardson, Texas

Demographic Data

The Regional Instructional Television Consortium (RITVC) provides broadcasting services to homes, public and private schools, and institutions within a 50-mile radius of the broadcasting site in Richardson. In the 1981-82 school year, the RITVC provided broadcasting services to 27 school districts, 2 private schools, 209 campuses and 138,965 students. Consortium planning operations began in 1977, and in the 77-78 school year began providing services to seven school districts, one private school, 99 separate campuses and 75,968 students. The size of school districts receiving services varies from the Dallas Independent School District with over 100,000 ADA, to 14 school districts with ADA below 3,000. Not all campuses in every school district receive services. School districts electing to receive services must invest in special receiver equipment such as installation of microwave antennas.

Uniqueness of Program

The RITV Consortium in Richardson is the second largest instructional TV consortium in the United States. A most unique feature is its governance which represents a multi-district cooperative effort employing a grass roots attempt to provide better services to school districts by sharing extensive resources that would otherwise not be available to them individually. Since its inception in 1977, the Consortium has expanded services both in terms of instructional content and geographic location. This program represents an excellent example of how education service centers, public schools, universities and commercial enterprises can coordinate to provide a wide range of services in a cost-effective way.

Description of the Program

The RITVC provides a wide range of instructional programming in all content areas to students in grades K-12. Through a committee of teachers and administrators selected from participating school districts, needs are assessed at the beginning of the year. Based on these needs, Consortium staff determine whether corresponding broadcast programs can be purchased or if they need to be developed. Budgets are allocated accordingly and a schedule of broadcasts is disseminated to participating school districts. Teacher and administrator input is constantly requested and used for further planning.

The 1980-82 budget for this program was $416,688. This included monies for Consortium staff, capital outlay, leasing and development of programs, staff development, and dissemination. The annual operating budget for this program piggybacked on already existing broadcast facilities which were in place in Richardson ISD and Mesquite ISD. These facilities had previously been funded through federal sources. Coordination through the RITVC provided for greater outreach and expansion of facilities that were already in place. Current operating budgets come from state instructional television allocations and a participating fee which is assessed to all participating districts.

Identified Strengths and Weaknesses

The RITV Consortium provides an example of high quality services that can be achieved when coordinated planning occurs with constant evaluation of both long-range and short-range goals. This program provides flexibility for a wide range of participating schools with varied populations in that it offers three types of broadcasting services:

1. Instructional television fixed services which require installation of a microwave antenna;

2. Cable television reception which is available in those communities having access to a cable franchise (RITV programs can then be received in the home); and

3. Video-tape programs for those school districts wanting to participate but not having the resources for installation of a microwave antenna. In such cases school districts may request a video tape of a particular broadcast. The Region X Education Service Center will tape the program through their media department and forward a copy to the requesting school district.

This type of flexibility provides the wide ranges of services to meet the individual needs of a very diverse population.

Future Plans

Plans for 1982-83 include expanding services to additional school districts as well as additional campuses in districts that are already participating. It is estimated that approximately 12,000 additional students will be served next year. Although services have primarily focused on those school districts within the Region X Education Service Center, several school districts in Region XI, geographically located within the RITVC, have requested the opportunity to participate in the broadcasting services. In May 1981, permission was granted Region XI to participate in the Consortium.

Warner-Amex TV Studio
Dallas, Texas

Demographic Data

Warner-Amex TV Studios provide broadcasting to three cities: Mesquite, Farmers Branch and most of Dallas. The diverse nature of the population of these areas provides an extremely wide range of listeners.

Presently the Dallas area has seven channels which are devoted to educational broadcasting. They include four channels for the Regional Instructional Television Consortium (RITVC), one for the Dallas Independent School District, one for the Community College and one for professional continuing education.

Uniqueness

This program represents an exemplary situation in which a commercial enterprise's cooperation with school districts, local schools, state agencies and university serve to bring about the finest educational materials and learning devices to students in a cost-effective manner.

Description of the Program

The Regional Instructional Television Consortium (RITVC) is working in cooperation with Warner-Amex and the Region X Education Service Center to produce video instructional material for grades K-12 on four channels to serve multiple independent school districts in North Texas. Present programming along these same four channels already includes educational material suitable for kindergarten through graduate education. The ongoing cooperation of these three systems is producing enhanced education by delivering constantly improved and varying programming to schools.

The cooperation is not only educationally effective, but cost effective. In comparison to the prohibitive costs to school districts in the past, the best educational and instructional packages are available at a relatively low cost, based solely on per capita in public schools.

Some of the other advantages of this cooperation include continuing education, diverse curriculum offerings, information to magnet schools, and good communication methods.

Because of the placement of some of their equipment, which is designated for education purposes, Warner-Amex has excellent community access. Some of their present locations include the public library, two high schools, community colleges and the administration building of the Dallas Independent School District.

Identified Strengths and Weaknesses

The Warner-Amex/Region X RITV Consortium provides an example of high quality services that can be achieved when coordinated planning occurs with constant evaluation of both long-range and short-range goals. This program of commercial-instructional planning provides flexibility for a wide range of participating community schools with varied populations.

Future Plans

Within three or four years, Warner-Amex service will be capable of providing services to all of Dallas through an expanded broadcasting range. They plan to have two educational specialists to deal with community use of the system as part of a staff of 30 professionals. Warner-Amex will also be offering interactive capabilities with applications to education as well as Narrowcast (addressable delivery). Projections also include a continuing education program at the college level.

TAGER Television Network

Demographic Data

The Association for Higher Education of North Texas (AHE) was incorporated in September 1960 by merger of the Association for Graduate Education and Research of North Texas (TAGER) and the Interuniversity Council. Seventeen institutes of higher education participate in the Association.

The Association operates two TAGER television network services. Since going on the air in 1967, TAGER has been successful in the delivery of undergraduate and graduate college and university courses between campuses and as an outreach to corporate classrooms. This is now known as the business service. This network offers two-way interactive audio links which allow direct communication between the student and classroom professor. A daily courier service delivers materials and exams to and from classrooms and campuses. The business service is generating over 2,000 credit and non-credit registrations each year.

In addition to the TAGER Television Network-Business Service, the Association operates the TAGER Television Network-Cable Service which programs four channels of general education, both credit and noncredit, for cable head-ends in the Dallas/Fort Worth area. The cable service is expected to serve more than 90,000 homes by the end of 1981.

Uniqueness

Whether employees wish to take a single course to improve their own or their department's productivity, or desire to pursue a full degree program to get the training needed for advancement—TAGER can deliver appropriate services. TAGER makes it possible for any company in the greater Dallas/Ft. Worth area to have a university virtually on its own site. Employees can pursue degree programs, have access to valuable up-to-the-minute technical knowledge, and participate directly with students at other industrial sites and on campuses in live, interactive television instruction. Furthermore, through the TAGER Television Network, its member colleges and universities listen and respond to the evolving and changing needs of local industries.

Description of the Program

The TAGER Television Network connects its member campuses and participating companies with one-way video, two-way audio transmissions. The closed-circuit, multi-channel network broadcasts courses for company participants on Instructional Television Fixed Services (ITFS) microwave frequencies assigned by the Federal Communications Commission.

A course originates in a production studio or studio-classroom at the offering institution and is distributed by the TAGER switching center to off-campus classrooms equipped to receive the microwave signal. This method of live, closed-circuit broadcast brings a view of the professor, his notes, demonstrations, models and everything else of instructional value directly to the company classroom with a closeness and quality not even one's personal attendance on campus can command.

A two-way audio link completes the delivery system. If any student viewing a class had a question of the instructor, or wishes to add to the remarks of a fellow classmate anywhere on the network, the student simply speaks into a talkback telephone instrument to be heard by all participants in the class.

TAGER allows for delivery of on-site courses by broadcasting up to four courses per hour, 14 hours each work day, designed to provide the critical special training required by engineers, scientists and other professionals.

Identified Strengths and Weaknesses

The TAGER Television Network, through its member institutions, taps a rich educational resource for the North Texas area. Courses are available at both the graduate and undergraduate levels, for credit and not for credit to assist employees in their continuing professional development.

Future Plans

Both networks expect to significantly enhance their programming with a satellite receiving station, funded by the National Telecommunications and Information Administration, which was activated in the summer of 1981. Within the next five years, the Association expects to expand to 26 channels and interlink its services with corporate and educational satellite systems. A satellite send capability will allow area institutions to offer their courses around the globe.

Appendix C

Survey Questions and Responses

County-District #

1. Do you utilize computer technology in your district?

   ______ Yes   ______ No

   If the answer is no, please indicate the reason(s) below for not using computers and skip to question #9.

   ______ lack of funds
   ______ lack of interest
   ______ lack of trained personnel
   ______ other (please list)

   ____
   ____
   ____

2. For what purposes do you use computers?
   ______ instruction
   ______ instructional management
   ______ administration
   ______ other

3. In which grade levels are computers utilized?
   ______ K-4
   ______ 5-6
   ______ 7-8
   ______ 9-12

4. How long has your district been involved in computer usage?
   ______ years

5. How many microcomputers do you have in your district? ______

6. What other type systems do you have?
   ______ none
   ______ mini
   ______ mainframe
   ______ other (please list)

   ____
   ____
   ____

7. Are the computers in your district compatible with (check all that apply)
   ______ each other
   ______ computers in other districts within your region
   ______ computers at your Regional Service Center

8. How was your instructional staff trained in computer use?

_________ university coursework
_________ program vendors
_________ Education Service Center
_________ local staff development (in-service)
_________ no training recieved
_________ other (please describe)

____
____
____

9. What computer services, if any, do you receive from your Education Service Center?

_________ administrative services (payroll, tax roll, etc.)
_________ test scoring, schedules, grades, etc.
_________ instructional materials
_________ staff training/assistance
_________ repair
_________ cooperative purchasing
_________ other (please describe)

____
____
____

10. How does your district determine which course software to purchase for its instructional program?

_________ user recommendation
_________ committee recommendation
_________ Education Service Center recommendation
_________ other (please describe)

____
____
____

11. Does your district utilize television in the classroom?

_________ Yes _________ No

If you answered no, please indicate the reason(s) below:

_________ service not available
_________ expense limitations
_________ lack of staff interest
_________ other (please describe)

____
____
____

12. What type TV programming do you utilize?

__________ do not use TV

__________ special events

__________ commercial programming

__________ Public Broadcasting Service

__________ other (please describe)

____

____

____

13. In which grade levels is TV programming utilized?

__________ K-4

__________ 5-6

__________ 7-8

__________ 9-12

14. With the increasing use of technology in instruction, is there support among administrators and teachers in your district for the concept of including computer literacy as a requirement in teacher training?

__________ Yes __________ No

RESPONSES TO SURVEY QUESTIONS CONCERNING TECHNOLOGY IN INSTRUCTION JULY, 1982

District Sub-Categories	Percent Statewide	Percent In Survey	Percent Utilizing TV	Reasons for not Utilizing TV: % Not Available	% Cost	% No Interest	% Combination
ADA Grouping							
Over 50,000	.5	.5	100	NA	NA	NA	NA
10,000-49,999	4.8	6.1	82	0	29	29	
5,000-9,999	3.1	3.2	67	0	67	17	17
3,000-4,999	7.7	8.3	58	11	33	6	33
1,500-2,999	11.9	11.9	66	6	24	29	35
1,000-1,499	8.5	8.0	56	29	19	14	33
500-999	18.9	20.4	41	25	26	12	28
100-499	35.8	33.8	31	33	23	13	27
Under 100	9.0	7.7	17	42	21	6	21
District Type							
Major Urban	0.7	0.9	100	NA	NA	NA	NA
Central Cities	2.9	3.6	62	0	38	25	38
Suburban	14.2	15.3	74	11	26	16	32
Non-Metro							
Over 1000	19.4	19.7	58	12	33	19	30
Small Town	21.8	23.5	41	23	26	18	29
Rural	40.9	37.1	25	37	24	8	25
Market Value/ADA							
Under 50,000	2.4	1.9	82	0	0	0	100
50,000-74,999	4.9	5.1	43	7	47	13	27
75,000-99,999	8.0	9.0	58	16	32	21	21
100,000-124,999	9.6	11.1	60	23	32	5	32
125,000-149,999	10.3	9.2	42	4	22	30	39
150,000-286,999	32.2	32.7	45	22	37	11	27
Over 287,000	32.5	31.1	33	41	14	12	25
TOTALS	1070.0	588	46	27	26	14	27

RESPONSES TO SURVEY QUESTIONS CONCERNING COMPUTER TECHNOLOGY JULY, 1982

	Percent Statewide	Percent In Survey	Percent Utilizing Computers	Purposes of Computer Use: Percent Instruct	Percent Admin	Percent Combination	Mean Number of Years Utilizing Computers	Percent Utilizing ESC Services	% Supporting Computer Literacy Rqmt. for Teachers
ADA Grouping									
Over 50,000	.5	.5	100	0	0	100	9.00	100	50
10,000-49,999	4.8	6.1	97	16	0	84	5.78	91	88
5,000-9,999	3.1	3.2	100	6	0	94	4.71	89	73
3,000-4,9000	7.7	8.3	100	27	4	69	3.85	90	84
1,500-2,999	11.9	11.9	86	16	5	79	4.39	91	75
1,000-1,499	8.5	8.0	72	26	13	62	3.45	79	58
500-999	18.9	90.4	63	45	5	50	2.57	79	68
100-499	35.8	33.8	48	45	16	39	3.22	74	53
Under 100	9.0	7.7	16	45	33	22	1.86	55	44
District Type									
Major Urban	.7	.9	100	0	0	100	8.40	100	75
Central Cities	2.9	3.6	100	10	0	90	4.53	89	76
Suburban	14.2	15.3	92	23	4	73	4.81	90	78
Non-Metro Over 1000	19.4	19.7	82	20	6	73	3.71	86	71
Small Town	21.8	23.5	65	47	8	45	2.66	82	66
Rural	40.9	37.1	40	42	18	40	2.89	78	53
Market/Value ADA									
Under 50,000	2.4	1.9	89	10	0	90	4.20	90	89
50,000-74,999	4.9	5.1	64	24	14	62	4.05	87	64
75,000-99,999	8.0	9.0	76	18	8	75	4.75	79	76
100,000-124,999	9.6	11.1	76	25	8	67	4.14	86	76
125,000-149,999	10.3	9.2	70	37	5	58	3.83	82	70
150,000-386,999	32.2	32.7	69	33	8	59	3.60	77	69
Over 287,000	32.5	31.1	52	40	9	51	2.86	77	52
TOTALS	1070.0	588.0	64	32	8	60	3.85	79	63