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ABSTRACT

This report presents a series of policy recommendations from the members of the California Technology Project Distance Learning Task Force to the California State Department of Education and the State Legislature on future directions for distance learning for kindergarten through twelfth grade schools. These recommendations are intended to assist California policymakers in the proper and economic application of distance education. The report begins with a brief overview of current educational conditions in California and a definition of distance education. Four educational problems are then identified and discussed, and Task Force recommendations are detailed for each problem: (1) a shortage of qualified K-12 teachers in California; (2) K-12 students in California have pressing instructional needs that cannot be met by their individual schools; (3) no one organization is responsible for distance learning in the state; and (4) current educational policies fail to recognize the "borderless" attributes of distance learning. The status of distance learning for K-12 schools in California is briefly described, including distance education by communications satellite and broadcast television, ITFS (Instruction Television Fixed Service), and cable television. Two examples of state supported distance learning networks are also provided: Oregon's Ed-Net, and the Community College of Maine. A list of Task Force members and a glossary of terms conclude the report. (DB)

Distance Learning for California Schools

Task Force Recommendations

California Technology Project Distance Learning Task Force

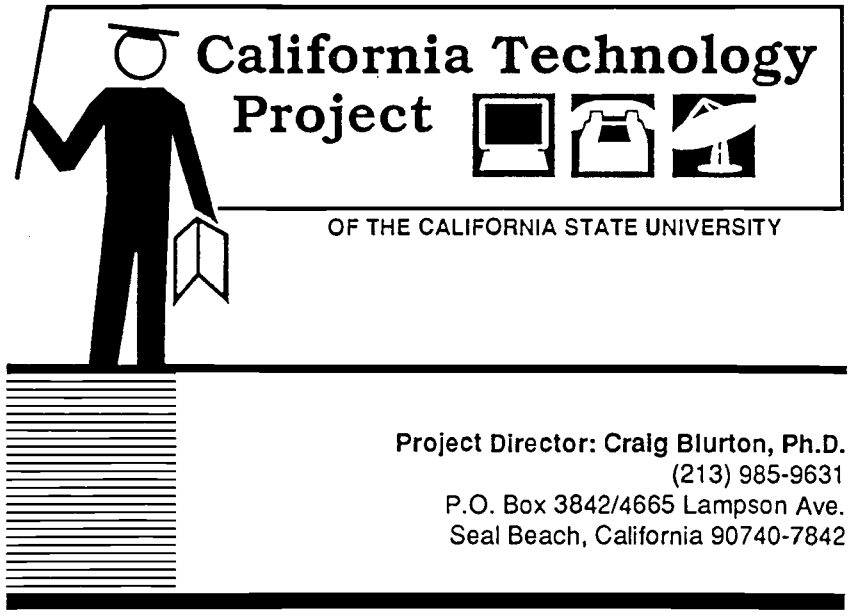
California Technology Project

OF THE CALIFORNIA STATE UNIVERSITY

Distance Learning for California Schools

Task Force Recommendations

Distance Learning Task Force
1990



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Forward

As part of its global effort to "bring the pieces together" in educational technology, the California Technology Project asked me to chair a task force to assist the state in making increased use of distance learning technology. This document and a companion resource guide have been produced through the hard work and sage advice of the California Technology Project's Distance Learning Task Force, a list of whose members is attached. In particular, the work of Deputy Chairs Hall Davidson and Judy Lieb was particularly appreciated.

The task force's recommendations are presented following sections which define distance learning and describe some of California's educational needs. In addition, the document provides examples of states which are leaders in using distance learning. The report also provides a glossary for those persons who are unfamiliar with distance learning terminology.

One point is very clear, California can and should fulfill some of its educational requirements through modern communications technology. I hope this document will help policy makers to plan for increased effective use of distance learning.

Robert Threlkeld
Chair, Distance Learning Task Force

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Introduction

As part of the California Technology Project's effort to coordinate educational technology in the State, a Distance Learning Task Force was established. The members of this task force represent a broad cross-section of California's educators -- local educators, higher education administrators, State Department of Education professionals, and others. All have an interest in and knowledge of distance learning. Among other assignments, the Task Force was charged with the following:

> *Develop a set of policy recommendations for presentation to the State Department of Education and to the State Legislature concerning future directions for distance learning for kindergarten through twelfth grade schools.*

This report fulfills that charge.

This document provides a series of recommendations from the members of the Distance Learning Task Force. These recommendations should help California policy makers in the proper and economic application of distance learning.

A companion document, *Distance Learning for California Schools: A Resource Guide*, provides a detailed description of current K-12 distance learning activities in California and the nation, as well as a primer and a glossary. Together, these documents will provide readers with a sense of the current status of live, interactive distance learning in the State.

Background: A Brief Look at Schools in California

Beginning with the 1983 document, *A Nation at Risk*, the American public has been taking a long hard look at its schools. That look has revealed a disturbing picture: we are failing our children. Test scores, in an undramatic and gentle decline, show that our children are learning less and leaving school earlier with each passing year. At a point when we need an ever more literate workforce, we are experiencing disappointing results from our K-12 educational system.

President Reagan began his State of the Union Address in 1987 by stating "The quest for excellence into the 21st century begins in the schoolroom, but we must go next to the workplace. We must enable our workers to adapt to the rapidly changing nature of the work place."

A declining birthrate is diminishing the number of new workers to fuel our economy. Between 1980 and 2000, the group of 18-24 year olds in the U.S. population will decline by 19 percent, while the overall population will increase by 18 percent. By 2010, one in every three 18 year-olds will be Black or Hispanic (compared to one in five in 1985). Providing effective service to these groups has been especially challenging to the Public Schools. The declining young population and increasing elderly population means that by 2050 there will be approximately one worker for each social security beneficiary. (Presently the ratio is about three to one.) By the year 2000, the traditional bulk of our labor force -- white males -- will shrink to 15 percent of those entering the labor market.

In a recent study by the International Association for Evaluation of Educational Achievement, U.S. twelfth graders ranked last among twelve developed nations in calculus, and second to last in geometry and algebra. U.S. students also ranked very low in biology, chemistry and physics.

American students appear to be losing interest in the key areas of science and engineering. The UCLA Higher Education Research Institute, which tracks student interest, has witnessed a steady decline of student interest in these two technical areas since 1983. These results are mirrored by the National Science Foundation's projections that from the pool of 4 million high school sophomores in 1977, only 2,700 will ultimately go on to a Ph.D. in science or engineering.

While there is no single solution to these problems, many of them can be addressed through the use of technology. A number of organizations have recognized this fact, and have written broad documents detailing how technology can assist California schools.

The California Post-secondary Education Commission recently produced *Technology and the Future of Education: Directions for Progress*. The Commission listed a series of recommendations for various governmental and educational institutions in the State, all directed toward the effective use of technology in education. Of particular note was the recommendation that "no student in the State, because of location or lack of teachers, is denied access to high quality instruction in a full range of subject areas. To ensure equity of access, greater use should be made of the delivery of instruction to off-site locations that technology allows."

Similarly, the California State University Commission on Instructional Technology, in its document, *The Student, The Faculty, and the Information Age: The Power of Technology*, recently put forth the following initiative:

> The CSU should actively support existing and encourage future campus efforts to develop telecommunications delivery systems designed to provide for intercampus or systemwide interaction amongst faculty, students, and staff, and in particular to serve non-traditional students/distance learners (e.g., professional educators in our K-12 system, corporate and other professionals in the workplace, agriculture and economic development endeavors).

Also, the Commission for the Review of the Master Plan for Higher Education, in its latest publication, *The Master Plan Renewed,* while not mentioning distance learning directly, addressed the use of technology in education with the following recommendation:

> The governing boards of the California State University, the University of California, and the California Community Colleges shall establish appropriate infrastructures in their systems and on their campuses so that the new instruction technologies are effectively integrated in support of the fundamental institutional missions.

The previous documents considered distance learning amidst all the various technologies which might be employed in education. In earlier statewide reports computer technology has been central in considerations, and scant attention has been paid to distance education. This report focuses on distance learning exclusively.

A Definition of Distance Learning

For the purposes of this report, the Task Force modified the general definition offered in the Office of Technology Assessment's recent publication, *Linking for Learning*: "Distance learning is the transmission of educational or instructional programming to geographically dispersed individuals and groups." The Task Force chose to concentrate on live, interactive televised instruction.

Students learning Japanese at their school in Anaheim via satellite from an instructor located in Arkansas is one example of distance learning. Students watching a taped instructional television program about the Japanese language is not distance learning as defined within this report, even though the technology used may appear similar. The difference is live interaction. The students in Anaheim can ask questions of their distant instructor and receive immediate responses.

Although the Task Force has focused primarily on live, interactive televised instruction, members recognize that there are many and varied technologies used effectively in distance learning, including live audio and audiographic conferencing, video tape, computerized courseware, and correspondence courses. However, live, interactive television is where the most explosive growth in technology and applications is occurring. This should not be construed to mean that distance learning is a separate and isolated use of technology. Rather, it is one of many uses of technology which can improve California schools.

There is a large body of work documenting the effectiveness of distance learning as a way of teaching and learning. Studies begun by the United States Armed Forces as early as the 1950s and a variety of studies done since in many subject areas and in many countries confirm that distance learning is at least as effective as face-to-face instruction. The intention of the Task Force is not to continue this documentation but to bring the documented effectiveness to bear on California education.

Educational Needs and Task Force Recommendations

Problem One: There is a shortage of qualified K-12 teachers in California.

a. *There is large body of new teachers who are working in the classroom while completing their credential coursework.*

According to a 1987 Rand Corporation report, U.S. school districts will need to hire 1 million new teachers between now and 1995 to fill projected vacancies in the public school teaching ranks. The projected deficiencies in California alone, which graduates 10% of the credentialed teachers in America every year, may be in excess of 100,000 by 1999. Because of the shortage of qualified instructors available to fill California's classrooms, many school districts have resorted to various forms of "emergency" credentialing. For example, prospective teachers with undergraduate degrees in liberal studies or in a subject area such as mathematics or history, but without formal education course work, are employed contingent upon their completing such course work during the first few years of their career. Completing courses is a critical problem for a teacher in this position, and many live in areas far from an institution of higher education.

b. *California students are being taught by teachers teaching out of their area of expertise.*

There are too few qualified instructors in some subject areas (such as foreign languages, mathematics and science). Fewer and fewer students are majoring in these critical areas in college, and even fewer are electing to become teachers when they graduate. This has resulted in the assignment of unqualified instructors to teach these subjects. The California Commission on Teacher Credentialing estimates that as many as 8% of certified teachers in California are teaching classes for which they are unqualified.

c. *There is a lack of credentialed teachers in California to work with students who need bilingual instruction.*

California's public schools are experiencing an influx of students with special language needs. Instructors who have earned state credentials to teach bilingual students are in short supply. By law, all California schools must offer instruction to children with special education needs, but some districts lack enough teachers with the proper training and credentials. Currently, California is producing approximately 12,000 bilingual teachers per year, but needs some 28,000 to adequately staff its schools. Thus the State is now experiencing a shortfall of 16,000 bilingual teachers, and this number is growing.

d. *Staff development training for educators is costly and time intensive.*

School districts spend significant sums of money for staff development activities to train teachers in the implementation of state frameworks and teaching strategies, and to help them become knowledgeable about the many educational programs being implemented in the state. Travel time between schools and the shortage of substitute teachers can hinder many of these staff development

activities. Like teachers, administrators find it difficult to leave their sites for training, and yet they also need to be informed about state and national programs that will benefit their students or enhance the educational process.

Task Force Recommendations for Problem One:

Use distance learning technology to provide on-site teacher education courses offered by schools of education.

Through distance learning, teachers would be able to attend classes locally, to meet basic credential requirements, to become proficient in a new subject area, or to attain additional credentials. Staff development inservices are easily provided by distance learning. The technology allows for live interaction, while pertinent materials can be sent to each location ahead of time. Experts from around the state and the country can be "brought" electronically to local sites for training.

The public and private institutions of higher education should actively support existing campus efforts and encourage future development of telecommunications delivery systems designed to serve non-traditional students/distance learners.

The State and educational institutions should make staff development teleconferences available to educators. These teleconferences should address timely issues in education as well as provide staff development opportunities.

The State should provide adequate resources for facilitating distance learning at local school sites.

Problem Two: K-12 Students in California have pressing instructional needs.

a. *Some high schools are unable to provide the breadth and depth of course work now required under the recent California educational reform movement.*

Tougher high school graduation requirements coupled with stricter admission policies in the State's two university systems has resulted in the reformation of the high school curriculum to include more course work in the sciences and mathematics, as well as other areas. Some California high schools, especially those in rural areas, are experiencing difficulty in offering the required courses because of a shortage of qualified instructors. Many teachers who might qualify to teach the required classes given appropriate inservice training live too far from the sources of such training to take advantage of them. High school counselors and advisors also need inservice training to fully understand the new regulations and their implications.

b. *Many students have little or no opportunity to learn about the ethnic and cultural heritage of others.*

Students in California schools represent a wide variety of cultures and ethnic backgrounds. Immediately adjacent to Mexico and facing the Pacific Rim, California's heritage is a story of mingling cultural and ethnic experiences. However, geographic isolation causes much of this history to go educationally unused, inaccessible within the confines of the classroom.

Task Force Recommendations for Problem Two:

Use distance learning resources to provide courses that are hard to staff or that only a few students are qualified to take.

Calculus, language instruction, and many college credit courses are currently offered via distance learning at a cost equivalent to or less than traditional classroom instruction. Small and rural schools can afford to offer classes via distance learning that otherwise could not be offered.

Teleconferences that involve students and educators in this state as well as students and educators in other parts of the world expand the walls of the school. Geographic isolation no longer exists and students can interact with their peers wherever they are.

To support these solutions, the state should gather and disseminate information on the level and types of most critically needed instruction, and either directly produce and support distance learning courses for California Schools, and facilitate the use of existing courses from organizations within and without the State.

Financial support for distance learning needs to be adequate to provide equitable access for all California school districts. Materials produced should be of the highest instructional and technical quality and should support the State Curriculum Objectives.

Problem Three: There is no one organization responsible for distance learning in the state of California.

California is characterized by a number of outstanding regional distance learning programs, but has no common mechanism to insure that students anywhere in the State have access to all courses. In order to guarantee equity and cooperation among the various educational sectors, many states have established statewide distance learning organizations. States with active programs include Iowa, Kentucky, Maine, Oregon, Texas and Virginia. While their mandates all differ somewhat, they share a common responsibility for the cultivation and support of distance learning in their states. To that end, each provides hardware and technology, along with organizational structure and support for the creation of distance learning courses for K-12 schools.

In addition to creating distance learning programs, the State should publicize those already in existence. With the myriad of teleconferences and distance learning courses available for students, it is difficult for schools to keep current on what is available. All too often information about a teleconference will come to a school or district only a few days before the event. Other times a district staff person may hear about a distance learning activity, but too late to arrange for a viewing site or too late to let other educators know about it.

Task Force Recommendations for Problem Three:

Designate or establish an organization to coordinate distance learning activities within the State of California.

The State of California should designate or establish an organization responsible for facilitating the development and financial support of K-12 distance learning. The organization should also coordinate dissemination of information on the various distance learning activities of educational providers to consumers in the State.

This organization should have the following functions:

a. Facilitate developing a statewide distance learning delivery system, using existing facilities wherever possible.

b. Gather and disseminate information on the grade level and types of most critically needed instruction for students and teachers.

c. Facilitate the acquisition of funds for the development of credit and non-credit courses to be delivered over the network.

d. Provide guidelines on instructional design and the development of effective learning environments for distance learning.

e. Monitor the quality and impact of distance learning programs by sponsoring regular research and evaluation studies.

f. Facilitate provision to schools of technical assistance in the acquisition and installation of distance learning hardware.

g. Lease or purchase one or more satellite transponders for use by California educational organizations.

Problem Four: Current educational policies fail to recognize the "borderless" attributes of distance learning.

One of the characteristics of distance learning is that students can be served over a large geographic area. Currently there is a wealth of educational programming transmitted from other states by satellite. More than 30 California school districts are now receiving 9-12 programming in this fashion. At the present time, any teacher who teaches California students must have a California credential, even if he or she broadcasts from another state. Clearly, a good physics teacher from Texas should be able to teach physics to students in California as well.

Task Force Recommendations for Problem Four:

California should identify and help eliminate legal and policy obstructions to the use of distance learning.

A number of states have recognized the policy impediments to distance learning. Oregon recently changed its credentialing regulations so that teachers who are credentialed in the state from which they are broadcasting are credentialed in Oregon. The elimination of this problem would ease the use of televised instruction in California schools. California should develop similar reciprocal agreements.

Islands of Excellence: The State of Distance Learning for K-12 Schools in California

California has been very involved with technology to deliver instruction off-campus for several years. The companion report to these recommendations, "Distance Learning for California Schools," describes the many and varied programs in detail. However, these efforts will be summarized here.

Distance Learning by Satellite and Broadcast Television

Satellite technology, which permits live programs to be sent throughout the State (and the nation), is being used to an increasing degree by educational organizations in California. The Los Angeles County Office of Education has made a strong and visible commitment to satellite education in the past two years by creating ETN (the Educational Telecommunications Network). Originally designed to telecast live and interactive staff development in the 80 districts in Los Angeles County, ETN now provides programming through county offices to districts in 35 counties in California. ETN utilizes a Ku-band uplink to provide teacher in-service training in curriculum reform areas. The network is also used for administrative training and informational teleconferences. In addition to providing live, interactive education, the EMDC (Educational Materials Development Center) provides extended staff development programs to membership counties.

For over a decade CSU Chico has been known nationally for its live, televised instruction by ITFS and satellite. The majority of its work involves the provision of regular university courses to off-campus centers. It also offers, through the satellite, master's degrees in computer science. In addition, CSU Chico delivers a significant amount of programming for K-12 students and teachers. The University is a partner in the TI-IN United Star Network, a Star Schools-funded national program. In this role Chico is providing a unique first-year teacher training program.

The Los Angeles Unified School District operates its own broadcast television station, KLCS, which offers a wide variety of televised instruction. Of particular note is its "Homework Hotline" which allows students to receive on-air tutoring after school. In addition to watching a live television tutor, students can call in during the broadcast and receive individual guidance.

To a lesser degree, other CSU campuses have been involved as well. Cal Poly Pomona has broadcast several university credit courses to advanced high school students. Cal State Sacramento offers regular grant-supported teleconferences in various disciplines.

Distance Learning by ITFS

California has made extensive use of ITFS (Instruction Television Fixed Service) within regional areas of the State. ITFS is a microwave technology which permits the delivery of live televised instruction to sites within 30-50 miles of the transmitter. Ten of the California State University campuses utilize this technology to provide education to public school teachers and students. Four of these campuses provide university credit course instruction to advanced high school students. Under this program, all student fees are either waived or reduced. County Offices of Education also utilize ITFS technology. Major ITFS public school networks exist in Fresno, Kern, San Diego, Santa Clara, and Monterey counties. In addition, many of the California Community Colleges are in the planning stage for using ITFS to serve schools.

Distance Learning by Cable

California also has distance learning infrastructure which links schools together by either traditional coaxial cable or by fiber optics. Many cable companies in the State broadcast live educational programs to schools and homes. The Sacramento Educational Cable Consortium represents a model cooperative cable-based program within Sacramento County. The Consortium serves 300 schools within the county. Programming decisions are made by a board with representatives from all the public school districts, as well as persons from the California Community Colleges; California State University, Sacramento; the University of California, Davis; and the public libraries.

Cable television can also be used for two-way delivery of video and audio. The Irvine Unified School District has been using two-way cable for live instruction for more than a decade. The University of California, Irvine, is connected to this system, and provides regular instructional programs to students and teachers in the district. California State University, Bakersfield, uses high capacity telephone lines to transmit two-way video between the campus and Tehachapi High School. The Bakersfield application represents some of the most recent advancements in distance learning technology.

Examples of State Supported Distance Learning Networks

One of the most pressing needs in California is for the development of some form of statewide distance learning structure for K-12 schools. Two states, Maine and Oregon, provide examples of how the various factions and constituencies can come together and produce a shared telecommunications network which benefits a variety of groups. Although both states are more similar to each other than to California, the examples suggest ways in which mutual interests can be served by cooperative planning.

Oregon's Ed-Net

In 1986, a voluntary committee of education and industrial officials funded a study of the value of a statewide telecommunications network in Oregon. The results proved so positive that the Oregon Department of Education performed a more detailed study, leading to the creation of Ed-Net, a multi-media network designed to provide the citizens of Oregon with access to education.

Oregon appropriated $8 million of lottery funds to establish the network, which is a hybrid of satellite, ITFS, compressed video, cable, and telephone lines. Ed-Net will have a single uplink located in Portland. Programming will be available from 30 sites, which will send signals to the uplink via land lines. The network will include the installation of 800 downlinks throughout the state.

The network is governed by a nine-member board, made up of officials from the various educational organizations, Oregon Public Broadcasting, and interested citizens. Ed-Net has a small administrative staff and depends on the Oregon Public Broadcasting organization for technical and administrative support.

The network will be used by K-12 schools from 8 a.m. to 1 p.m. five days per week. High demand courses will be broadcast live to any school which requires them. After 1 p.m. the network will be used to provide adult and graduate education courses from higher educational facilities.

Ed-Net is designed to be self-supporting after four years. Funds will come from annual subscription fees, plus charges to organizations which originate programming. The network is aware that video transmission is expensive, and will therefore subsidize courses.

The Community College of Maine

Like Oregon, Maine is a large state with a small and dispersed population. The state in general, and K-12 education in particular, suffers of lack of access to educational resources. In November, 1985, after two years of planning, the University of Maine Trustees approved the plan for the establishment of a Community College of Maine/Telecommunications System.

The Community College of Maine is designed as a vehicle to provide citizens with education delivered using telecommunications technology. Although the state looked briefly at satellite technology, it ultimately selected a combination of fiber optics and ITFS, linking all the University of Maine campuses, the vocational colleges, and ultimately every high school in the state. The program is funded through the Maine legislature, and the lead campus is the University of Maine at Augusta. All technology is handled by the Maine Public Broadcasting Network.

As of September, 1989, 23 high schools were on-line with the network. Forty courses are being offered. Many are high school credit courses sponsored and developed by the Maine Department of Education and Cultural Services. High school students also have access to university credit courses at regular tuition rates. After school hours, credit university courses are broadcast to teachers. In addition to the school programming, the higher educational institutions share programming among the campuses.

Schools which participate in the program are supplied with necessary receiving hardware and pay nothing for the televised service. Maine plans to ultimately have each high school in the state equipped with two viewing areas.

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Glossary of Distance Learning Terms[1]

The following glossary contains a listing of terms which relate to the broad field of distance learning. Many of these terms relate to non-video technologies, and are therefore not used in this report. However, the definitions will be of value to anyone who is interested in the full spectrum of technologies used in distance education.

ACTS — Advanced Communications Technology Satellite. A National Aeronautics and Space Administration Ka-band satellite that is scheduled for deployment in the early 1990s.

addressable converter — A device connected to a television set that allows cable television operators to turn on or block individual subscriber access to pay-per-view service.

amplifiers — Electronic devices, spaced at intervals (cascaded) throughout a cable television system, used to boost the strength of the cable signal as it passes from the headend to the subscriber. In coaxial cable systems, amplifiers are needed approximately every 1,500 feet.

analog communication — A communication format in which information is transmitted by modulating a continuous signal, such as a radio wave. See also digital communication.

asynchronous communication — Two-way communication in which there is a time delay between when a message is sent and when it is received. Examples include electronic mail and voice mail systems.

audio bridges — Electronic devices that connect and control multiple telephone lines for audio and data applications, allowing many callers to be connected as a group simultaneously. Used for audio conferencing.

audio conferencing — An electronic meeting in which participants in different locations use telephones to communicate simultaneously with each other.

audiographics — An advanced computer application in which computer interaction is augmented by two-way, real-time audio communication. Audio, data, and graphics are shared over regular telephone lines, allowing users in different locations to work on the same application simultaneously.

bandwidth — The width of frequencies required to transmit a communications signal without undue distortion. The more information a signal contains, the more bandwidth it will need to be transmitted. Television signals, for example, require a bandwidth of 3 million hertz (cycles per second), while telephone conversation needs only 3,000 hertz.

bit — Binary digit. The smallest unit of information a computer can use. A bit is represented as a "O" or a "1" (also "on" or off"). A group of bits is called a byte. Bits are often used to measure the speed of digital transmission systems.

[1] Abstracted with permission from *Linking for Learning: A New Course for Education*, Office of Technology Assessment, Washington D.C., 1989.

Bell Operating Companies (BOCs)	As a result of the divestiture of AT&T in 1984, the original Bell telephone system was divided into 22 local Bell Operating Companies that now provide local telephone service across most of the country. These companies are controlled by the seven "Baby Bells," the Regional Bell Operating Companies (RBOCs).
Bulletin Board Service (BBS)	A computer service that allows remote users to access a central "host" computer to read and post electronic messages. Communication is usually asynchronous.
C-band	The designation for satellite communications operating at 6 GHz (billion cycles per second) uplink and 4 GHz downlink. These frequencies are also used for terrestrial microwave transmission.
coaxial cable	Shielded wire cable that connects communications components together. It is commonly used in cable television systems because of its ability to carry multiple video (or other broadband) signals.
codecs	The abbreviated form of "coder-decoder." Electronic devices that convert and compress analog video signals into digital form for transmission, and convert them back again on reaching their destination.
compact disc-read only memory (CD-ROM)	An optical storage system for computers that only allows data to be read off the disc. New data cannot be stored and the disc cannot be erased for reuse.
compressed video	A video signal requiring less information to transmit than broadcast quality of full-motion video. Digital technology is used to encode and compress the signal. Picture quality is generally not as good as full-motion; quick movements often appear blurred. Compressed video requires transmission speeds between 56 kbps and 2.0 Mbps.
computer conferencing	Allows individuals at different locations to communicate directly with each other through computers. Communication may be in real-time or delayed.
digital communications	A communications format used with both electronic and light-based systems that transmits audio, video, and data as bits ("1s" and "Os") of information (See Bit). Codecs are used to convert traditional analog signals to digital format and back again. Digital technology also allows communications signals to be compressed for more efficient transmission.
digital video interactive (DV-I)	A system that combines audio, data, and limited-motion video on an optical disc. DV-I will run on a personal computer, allowing the user to control interactive program.
directed broadcast satellite (DBS)	Satellites that operate in the 12.2 to 12.7 GHz frequency band. These satellites are designed to broadcast programming directly to small (1 meter) home receiving dishes. No such services are currently operating in the United States.
downlink	An antenna shaped like a dish that receives signals from satellite. Often referred to as a dish, terminal, Earth station, TVRO (television receive only).
downstream	The direction a signal travels as it moves from the transmitting (origination) site to the receiving sites.

electronic blackboard	A computer application that allows graphics to be shared among many computers simultaneously. Each user can see and annotate the graphics as needed. The results will be visible to all users.
facsimile machine (FAX)	A telecopying device that electronically transmits written or graphic material over telephone lines to produce a "hard copy" at a remote location.
FCC	Federal Communications Commission.
fiber optics	Hair thin, flexible glass rods that use light signals to transmit audio, video, and data signals. Signals can be sent in either analog or digital format. Fiber optic cable has much higher capacity than traditional copper or coaxial cable, and is not as subject to interference and noise.
footprint	The area on the Earth's surface to which a satellite can transmit. Different satellites cover different areas and have different footprints. Satellite footprints generally cover all the continental United States (full conus) or only half of it (half conus coverage).
freeze frame	One method of transmitting still images over standard telephone lines. A single image is transmitted every 8 to 30 seconds. Also referred to as slow scan.
frequency	The number of times per second an electromagnetic wave completes a complete cycle. A single hertz (Hz) is equivalent to one cycle per second.
full-motion video	A standard video signal that can be transmitted by a variety of means including television broadcast, microwave, fiber optics, and satellite. Full-motion video traditionally requires 6 MHz in analog format and 45 Mbps when encoded digitally.
Gbps	Giga (billion) bits per second. See bit.
GHz	One billion hertz (cycles per second). See frequency.
graphics tablet	A computer device resembling a normal pad of paper that users draw or write on. The graphics tablet converts hand-drawn images into digital information that can be used and displayed by a computer.
headend	In a cable television system, the headend is the central transmission office from which programming is distributed to subscribers.
high definition television (HDTV)	An advanced television system that produces video images as clear as high-quality photography. HDTV is still experimental in the United States.
Instructional Television Fixed Service (ITFS)	A band of microwave frequencies set aside by FCC exclusively for the transmission of educational programming. Allows broadcast of audio, video, and data to receive sites located within 20 miles. Receive sites require a converter that changes signals to those used by a standard television set.
Integrated Services Digital Network (ISDN)	An end-to-end digital network that will allow users to send voice, data, and video signals over the same line simultaneously. Narrowband services now in operation give users up to 24 channels to send voice and data information, with a combined capacity of up to 1.544 Mbps. In the future, broadband services available over a public ISDN are expected to offer full-motion video services as well.

Ka-band	Satellite communications frequencies operating at 30 GHz uplink and 20 GHz downlink.
Kbps	Kilo (thousand) bits per second. See bit.
KHz	Kilohertz; thousand cycles per second. See frequency.
Ku-band	Satellite communications frequencies operating at 14 GHz uplink and 12 GHz downlink.
light emitting diodes (LEDs)	Used as transmitters in some fiber optic systems. They transmit digital bits as pulses of light along a fiber optic strand.
Mbps	Mega (million) bits per second. See bit.
MHz	Megahertz; million cycles per second. See frequency.
microwave	High-frequency radio waves used for point-to-point and omnidirectional communication of audio, data, and video signals. Microwave frequencies require direct line-of-sight to operate; obstruction such as trees or buildings distort the signal.
modem (modulator/ demodulator)	A device that converts digital computer signals into analog format for transmission.
Modification of Final Judgement (MFJ)	The 1984 agreement that brought about the divestiture of AT&T, and limited the Bell Operating Companies' involvement in manufacturing and designing equipment, as well as their ability to provide long distance and information services.
modulation	The process of encoding audio or video signals onto a radio wave (carrier frequency) for transmission.
multiplexer	A device that combines multiple signals for simultaneous transmission over a single channel.
multipoint distribution services (MMDS)	Also MMDS; Multichannel Multipoint Distribution Service. Also known as "wireless" cable. A telecommunications service that uses microwave signals to transmit video entertainment and data.
Public Switched Telephone Network (PSTN)	The public telephone network.
real-time communication	Two-way simultaneous communication, as opposed to asynchronous.
repeater	A device used to extend the range of a communication signal.
reverse flow amplifier	In two-way cable television systems, these devices move video and audio signals from the receive sites back to the cable headend.

Signaling System 7 (SS7)	A recent development in control systems for the public telephone company computers to communicate with each other, making telephone call processing faster and more efficient and enabling more services to be made available to consumers.
slow scan	See freeze frame.
steerable dish	A satellite receive dish that uses motors to rotate the dish to receive signals from many satellites. "Fixed" dishes are stationary, always pointed at the same satellite, unless reaimed by hand.
switched network	A type of system where each user has a unique address (such as a phone number), which allows the network to connect any two points directly.
T-1 rate	A digital transmission speed of 1.544 Mbps.
teleconferencing	A general term for any conferencing system using telecommunications links to connect remote sites. There are many types of teleconferencing including: video conferencing, computer conferencing, and audio conferencing.
television receive only (TVRO)	Satellite dishes only capable of reception.
touch screen	A computer screen that allows data to be entered by using a specialized pen to write on the screen, or by making direct physical contact with the computer screen.
transponder	The electronic equipment on a satellite that receives signals from an uplink, converts the signals to a new frequency, amplifies the signal, and sends it back to Earth. Satellites are usually equipped with 12 to 24 transponders.
uplink	A satellite dish that transmits signals up to a satellite.
upstream	The direction a signal travels as it moves from a receive site back to the site of original transmission. Used especially in two-way cable television systems.
vertical blanking interval (VBI)	The unused lines in a standard television signal. The VBI appears as a black band at the top or bottom of a television picture. Often used for closed captioning.
very small aperture terminals (VSATs)	Satellite receive dishes, approximately 1.8 to 2.4 meters in diameter, that are capable of sending and receiving voice, data, and/or video signals.
videophone	A telephone combined with a video screen, allowing callers to see each other as they speak.