

TI-IN
NETWORK



ETNO

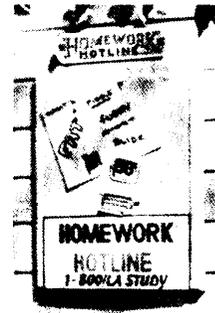
PENNSYLVANIA
TELETEACHING PROJECT

Chapter 2

Distance Education in Today's Classroom

KET

KET
Network



ASTS

Oklahoma State University



NASA
National Aeronautics and
Space Administration

PACE

PROVIDING ACADEMICS COST EFFECTIVELY



A range of public and private sources provide distance learning programs and materials to schools today.

CONTENTS

	<i>Page</i>
FINDINGS	25
SNAPSHOTS OF DISTANCE LEARNING	26
Where Has Distance Learning Taken Hold?	27
Who Is Being Served?	28
What Is Being Delivered?	31
How Are Educational Materials Being Delivered?	33
Who Are the Providers?	38
How Are Distance Learning Systems Being Paid For?	43
Is Distance Learning Effective?	44

Boxes

<i>Box</i>	<i>Page</i>
2-A. The Star Schools Program in Mississippi	29
2-B. Kids Interactive Telecommunications Project by Satellite	34
2-C. Panhandle Shar-Ed Video Network	36

Figure

<i>Figure</i>	<i>Page</i>
2-1. Panhandle Shar-Ed Video Network	37

Tables

<i>Table</i>	<i>Page</i>
2-1 ₀ Growth unselected Distance Learning Projects Between 1983-89	27
2-2. Whole Courses Offered in the United States in 1988-89 by Selected Distance Learning Projects	32

Distance Education in Today's Classrooms

Distance education can be broadly defined as the transmission of educational or instructional programming to geographically dispersed individuals and groups.¹ This form of instruction has evolved as telecommunications and information technologies have advanced. Correspondence courses, the earliest form of distance education, began in the late 19th century. As early as 1938, educators concerned with the distant learner formed the International Council for Correspondence Education.² Instructional television (ITV) was a much-touted distance learning model in the 1960s; although ITV fell far short of early expectations, today's telecourses and educational programs reach many learners in diverse settings.

Today, distance education is flourishing in this country and abroad. Large numbers of students in higher education in the Soviet Union, East Germany, and China are distant learners.³ Britain's Open University is a long-standing model for comprehensive educational services delivered at a distance.

In the United States, at the adult level, distance education has been embedded for many years in the corporate, military, and university continuing education sectors. The technological spur for the rapid expansion of distance learning efforts in the past 5 to 10 years was the advent of video conferencing technologies, which allowed two-way interaction. In 1987, there were over 40 generic delivery systems that provided video conferencing to business, in addition to the many private networks in place. The National Technological University is a network providing about 500 engineering post-graduate courses from 24 major universities to over 100 workplaces.⁴

The widespread adoption of computers in schools and the ability to connect them expanded opportunities for two-way interaction among distant loca-

tions. Recent technological advances, including development of fiber optics, have expanded the capabilities for two-way interaction even further.

The more important spur for the growth of distance education in K-12 applications, however, has been the needs of the education community itself. Specific problems led to the trend, especially shortages of fully qualified mathematics, science, and foreign language teachers, increased standards for high school graduation, more stringent admission requirements by colleges, and increased demands for inservice training and professional development. These challenges, combined with opportunities presented by new information technologies, caused educators and policymakers to look beyond traditional approaches and consider distance education.

In this study, distance learning is defined as teaching-learning arrangements in which the teacher and student are separated physically; in these applications, a portion or all of the learning interactions occur in real time. Although distant delivery of information via broadcast, computer data links, and other means also provides important resources for the classroom and valuable tools for learning, they are not the principal focus of this special report. This chapter describes the current picture of K-12 distance education in the United States and examines key issues for planning and future development.

FINDINGS

- **Providing courses for underserved or advanced students is the principal application of distance learning for K-12 education.** An increasing number of efforts, however, include modules and enrichment activities for classroom instruction, and staff development and inservice

¹Ellen D. Wagner, "Instructional Design and Development: Contingency Management for Distance Education," paper presented to The American Symposium on Research in Distance Education, July 24-27, 1988, p. 12. This broadly sketched definition serves as an appropriate departure point for this special report.

²In 1982, the International Council for Correspondence Education changed its name to the International Council for Distance Education, in recognition of the variety of media that serve education. Michael G. Moore, Pennsylvania State University, "Effects of Distance Learning: A Summary of the Literature," OTA contractor report, May 1989.

³In China, almost 50 percent of postsecondary students use distance learning; in the Soviet Union, 30 percent; in East Germany, 25 percent. *Ibid.*, p. 7.

⁴*Ibid.*, pp. 2-3.

training for teachers and administrators. Despite the explosive growth of distance learning in K-12 education, access to these resources varies nationwide.

- **Distance education has brought new providers into the education field.** Business and higher education, two groups with long track records using distance learning, are now providing educational programming and services to the K-12 market. Schools are learning from the experiences of other distance education users, engaging in innovative partnerships, and choosing from a range of technical and programming alternatives.
- New coalitions across State and district boundaries, new networks of educators, and geographically dispersed schools receiving programming from common providers exemplify changing relationships in the education community. Educators involved in interactive instruction, computer networking, and instructional television, although developing separately, are coming together. **Connections now being established across geographic, instructional, and institutional boundaries provide opportunities for collaboration and resource sharing among many groups for the coming years.**
- Telecommunications and information technologies are increasingly flexible tools, providing links to other resources for problem solving, communication, and manipulation of data, and enabling students and teachers to expand educational horizons. **There is no single best model of distance learning.** The quality and effectiveness of distance learning are determined by instructional design and technique, the selection of appropriate technologies, and the quality of interaction afforded to learners.
- Most K-12 distance learning activities for students are video-based. **However, there are many technological options for delivering education over a distance, and the ability of the teacher and students to see each other may not be a necessary condition for effective distance**

learning. Models of teaching strategies based on computer applications, for example, are emerging that may be equal to or more effective than video-based instruction or traditional instruction. **Further research and experimentation with innovative teaching strategies and technologies is needed.**

- Distance learning has proven effective in adult learning and training settings. This suggests that distance learning can be effective in the elementary and secondary schools, but research in K-12 applications is limited. **However, existing research, project evaluations, and anecdotal evidence strongly suggest that distance education is an effective means for delivering instruction and educational resources to students and teachers.**
- **Telecommunications systems that serve education can also benefit the community at large, and vice versa.** New uses include the application of information and educational resources for K-12 students, adults, senior citizens, local government and organizations, and business. **In rural areas especially, telecommunications systems and services are tied increasingly to economic development and community survival.**

SNAPSHOTS OF DISTANCE LEARNING

The picture we have of distance education in today's classrooms is at best a series of snapshots. This is because efforts are new and continually changing. The snapshots in this report are based on the OTA 1988 survey of State technology activities,⁵ other information provided by the National Governors' Association and the Council of the Chief State School Officers, seven case studies of distance learning,⁶ and OTA site visits and participation in various conferences on distance learning. Additional information on various projects was provided by program offices in several Federal agencies, and by

⁵This survey was conducted as part of OTA's assessment on educational technology in elementary and secondary education. See U.S. Congress, Office of Technology Assessment, *Power On! New Tools for Teaching and Learning, OTA-SET-379* (Washington, DC: U.S. Government Printing Office, September 1988).

⁶Bruce Barker, Texas Tech University, "Distance Learning Case Studies," OTA contractor report, May 1989.

a number of State education agencies.⁷ Finally, OTA was contacted by various projects across the country who shared information on their efforts.

There are several clear trends. **Distance learning is expanding.** Until recently, few States or districts had either projects or plans for distance education at the K-12 level. Fewer than 10 States were investing in distance learning in 1987; 1 year later two-thirds of the States reported involvement.⁸ Today, virtually all States have an interest or effort in distance education.⁹ Within States, a growing number of efforts involve local districts, regional education service centers, nearby universities, and community colleges. Student enrollment in distance education courses provided on a local, regional, or national basis has increased. (See table 2-1.) While a national survey of representative school districts indicated that an estimated 22 percent of school districts now use distance learning, some 33 percent expect to be using these resources by 1990.¹⁰

The second trend is more subtle. **Distance learning is changing educational boundaries—boundaries traditionally defined by location and by institution.** In the pooling of students and teachers, distance learning efforts reconfigure the “classroom.” No longer bound by the physical space, classrooms extend to other students in the same district, to other districts, to other States, or even across national borders. When this happens, institutional arrangements necessarily change. Thus, a high school course in German may be taught by the local high school teacher, the German teacher four districts away, or a university professor.

The assortment of educational providers, institutional arrangements, academic subjects, and technologies is striking. Boxes throughout this report illuminate this diversity of efforts and interests. The balance of the chapter shows more snapshots, and highlights many characteristics of current distance education efforts.

Table 2-1--Growth In Selected Distance Learning Projects Between 1983-89

Minnesota Distance Learning projects	
Earliest operating projects:	1983
Number of projects:	1983-84-1 1988-89-17
Number of courses:	1983-84--less than 10 courses offered 1988-89-139 courses offered
Number of students:	1983-84-information not available 1988-89-3,869 students
Number of sites:	1983-84--4 districts 1988-89-107 districts
Arts and Sciences Teleconferencing Service (ASTS)	
Year begun:	1984; pilot program offered in fall of 1985
Number of courses:	1985-86-1 course offered 1988-89--7 courses offered
Number of students:	1985-86---333 students 1988-882,500 students
Number of sites:	1985-86-50 districts in 2 States 1988-89-236 districts in 19 States
Staff development:	1985 -86--video teaching workshops offered 1988-89 programs, each 2.5 hours
TI-IN Network	
Year begun:	1985
Number of courses:	1985-86-14 courses offered 1988-8-25 courses offered
Number of students:	1985-86-350 students 1988-89--4,000 students
Number of sites:	1985-86-50 schools in 3 States 1988-89-780 schools in 32 States
Staff development:	1986-87-offered 400 hours of programming yearly 1988-89-offered 400 hours of programming yearly
Satellite Telecommunications Educational Programming (STEP) network	
Year begun:	1986
Number of courses:	1986-87--5 courses offered 1988-89--5 courses offered
Number of students:	1986-87--230 students 1988-89--855 students
Number of sites:	1986-87--13 school districts in 1 State 1988-8-58 school districts in 8 States
Staff development:	1988-89-offered 20 different programs 1986-87-offered 2 different programs

SOURCE: Office of Technology Assessment, 1989, from data provided by the projects listed above.

Where Has Distance Learning Taken Hold?

Impetus for K-12 distance learning has come primarily from the Nation's rural schools. Shifting economic and demographic patterns have left many

⁷Some States have completed extensive surveys and assessments of distance learning activities in K-12 education; others have also prepared the groundwork for either statewide or regional efforts that will begin in the near future. See for example, Office of the Superintendent of Public Instruction, *Report to the Legislature on Linking for Learning: K-12 Educational Telecommunications Plan* (Olympia, WA: December 1988); Michigan State Board of Education, *Inventory of Instructional Telecommunications Systems in Michigan* (Lansing, MI: March 1989); and Texas Education Agency, 1988-2000 *Long-Range Plan for Technology* (Austin, TX: December 1988).

⁸National Governors' Association, *Results in Education: /988* (Washington, DC: 1988).

⁹See ch. 5. See also State and local activities profiled in app. A.

¹⁰Jeanne Hayes, Quality Education Data, Inc., personal communication, August 1989, from data collected in the QED 1989-- Technology Trends Survey. Quality Education Data, Inc., *Microcomputer and Video Purchasing and Usage Plans: 1989-90 School Year* (Denver, CO: 1989).

small and rural schools with declining student populations and even more limited financial and instructional resources. At the same time, States have increased requirements for curriculum, graduation, and teacher training, and colleges and universities have toughened entrance requirements. Solutions such as school consolidation or transporting students or teachers have often been stretched to their geographic limits; these approaches are also disruptive and politically unpopular. The local school is the heart of the community in most rural areas. If the community is to thrive and grow, so too must the school. Increasingly, small rural schools have turned to distance learning as a way of keeping their local character while still offering students a range of educational resources. (See chapter 5, box 5-c.)

Mismatches between student needs and qualified teachers are not limited to rural schools. Large urban school districts also face problems hiring qualified teachers in fields such as English as a second language, special education, and advanced mathematics and science. In addition, urban districts also face problems regarding parental involvement, cultural relations, and staff development and training. Suburban and urban districts are beginning to look to distance learning to meet some of these needs. **Distance learning, once perceived as a resource for the geographically isolated school, is becoming a solution for overcoming other educational deficiencies.**

Who Is Being Served?

Grades 9 to 12

Many students served by video-based distance learning today are high school students taking courses to fill graduation or college entrance requirements that their schools cannot provide on site. Many schools cannot afford to hire teachers for calculus or French if only five or six students will take the class; other schools cannot convince teachers qualified in these subjects to live in their part of the country.

Gifted and Talented Students—A large portion of the secondary school students receiving distance instruction today are academically gifted and talented students—those whom teachers feel can “handle” the unique circumstances of being taught by a teacher outside the classroom. These students are likely to be more self-motivated, and thus may not even need to have an adult in the classroom to keep them on task. It has been assumed (although empirical evidence is sparse) that distance learning courses typically require more mature and motivated students in order to be effective.¹¹ Interaction with the teacher is changed, and more responsibility is placed on the learner. Those not committed may find it difficult to keep up.

Undeserved and Disadvantaged Students—The Federal Star Schools Program requires that at least 50 percent of funding for projects serve educationally disadvantaged students and schools. This commitment has spurred the growing trend for distance learning systems to reach these populations. Some States receive an interactive distance learning curriculum through the Star Schools Program. (See box 2-A.) Other systems have long had as a goal providing instruction to culturally isolated or economically disadvantaged populations. Activities supported by the Bureau of Indian Affairs (BIA) and by the State of Alaska, for example, reach underserved populations on Native American reservations and in remote Native Alaskan villages, respectively. Although few homebound and physically handicapped students currently have access, they are ideal candidates for interactive distance education. Telecommunications learning opportunities could be extended to other groups of learners who, for a variety of reasons, are educationally disadvantaged or culturally or physically isolated.¹²

Grades K to 8

Very young students have also begun to benefit from distance learning technologies. In the lower grades, classroom teachers often use enrichment materials provided via telecommunications. Public television stations have been offering instructional

¹¹See the section, “Is Distance Learning Effective?” later in this chapter. Because distance learning has been used so effectively with **adult learners**, and is only now being tested with learners who may not be self-motivated, many people assume that such maturity is necessary for a student if distance learning is to succeed. Little hard evidence for this conclusion **exists**; it is possible that **as** distance learning is applied more to at-risk **students**, and **instructional** design is improved to overcome the barriers of geography or culture inherent in the process, such instructional **methods** could be even more beneficial for students who do not meet the characteristics of the **adult** learner. See A.W. Bates, “Television, Learning and Distance Education,” *Journal of Educational Technology*, vol. 14, No. 3, 1988, pp. 213-225.

¹²For discussion of the various kinds of isolation that distance learning can overcome, see Jason Ohler, university Of Alaska Southeast, “Distance Education and the Transformation of Schooling: Living and Learning in the Information Age,” OTA contractor report, May 1989.

Box 2-A—The Star Schools Program in Mississippi

Significant Federal resources, as well as some State and local resources, are flowing into Mississippi for distance learning. Three of the four projects funded under the Federal Star Schools Program serve Mississippi. Two universities, the State education agency, and the State educational television network are partners in the Star Schools consortia. A total of 112 schools in the State will be served by the Star Schools grantees (Midlands Consortium, TI-IN United Star Network, and Satellite Educational Resources Consortium-SERC) in 1989-90; another 50 schools will be added using second-year Star Schools funding. This interest in Mississippi is due, in part, to the requirements of the Star Schools legislation that at least 50 percent of the funds serve Chapter 1-eligible school districts and the educationally underserved. All of Mississippi's 152 school districts are Chapter 1-eligible.

The Midlands Consortium, through its Mississippi partner, the University of Mississippi, is concentrating efforts in three areas: placing satellite downlinks and associated equipment in schools, training school personnel in the use of the technology, and conducting research and evaluation. Sixty-five schools received downlinks through the Consortium and 100 teacher/facilitators from these schools participated in training workshops in July 1989. Three research projects on satellite-based distance education are in progress.¹

One of the partners in the TI-IN Network, Mississippi State University, is producing teacher inservice courses in mathematics and science, taking advantage of the university's noted strength in science and engineering. In addition, Mississippi teachers will be able to take courses or institutes in teaching junior high science, Earth sciences, theory of equations, and physics that will be offered throughout the nationwide TI-IN Network during the 1989-90 school year. The Star Schools TI-IN funding also supported the installation of 33 satellite downlinks at schools in the State; another 25 schools will receive equipment through the second-year grant.

SERC partners include the Mississippi State Department of Education and the Mississippi Authority for Educational Television. SERC has placed satellite downlinks in 14 schools in Mississippi. SERC offered courses to selected schools in the 1988-89 school year as a pilot test, and will offer expanded classes and staff development in 1989-90.

Another factor in the Mississippi picture is the aggressive educational reform effort under way in the State. Major components of that effort include full-day, statewide kindergarten, teacher aids for K-3 classes, and new procedures for school accreditation, teacher certification, staff development, and teacher evaluation.² Governor Ray Mabus is expected to announce another package of educational reforms including a proposal for a statewide Instructional Television Fixed Service system.

The State Department of Education plans to evaluate distance learning outcomes. If proven effective, distance delivery of classes may affect key elements of the State reform efforts. For example, the State has emphasized raising standards for schools through performance-based accreditation reviews. This has created pressures to close many small high schools that are unable to offer the full range of courses required by State reforms. If distance delivery of classes proves effective, consolidation may not be needed.

The State Superintendent of Education's office and the Star Schools grantees solicited written commitments for the term of the grants from all the local school boards with distance learning sites. Local commitment is crucial for ensuring the survival of these projects. However, it is unclear whether all the Star School sites will be able to fund distance learning once the Federal subsidies disappear.³

One of the primary objectives of the Star Schools legislation was to serve disadvantaged students like those in Mississippi. Mississippi's experience with Star Schools may demonstrate interactive distance learning's capacity to offer important educational opportunities to students from resource-poor homes and communities. It will be important to follow the progress of these three different efforts, and to study the dynamics of Federal investments in distance learning in a State with both a commitment to educational reform and significant educational deficiencies.

¹Robert A. Young, director, Office of Distance Learning, University of Mississippi, testimony before the Senate Subcommittee on Education, Arts, and Humanities of the Committee on Labor and Human Resources, Apr. 27, 1989.

²Olon E. Ray, Special Assistant to the Governor, testimony before the Senate Subcommittee on Education, Arts, and Humanities of the Committee on Labor and Human Resources, Apr. 27, 1989.

³Pat Teske, Office of the State Superintendent of Education, Mississippi Department of Education, personal communication, August 1989.



Photo credit: Pennsylvania Teleteaching Project, Mansfield, PA

thfu tfe ders ca rece e g co rse
 erw se avai abe em w e carcera ed
 ng ma Pe ana N rt Ce a Sec
 eatme U taki g a mp te p og amn ng co rse
 se a a dograp cs from Dan e Hg Sc oo

television for many years for these students and others. *13* *Contact, The Voyage of the Mimi, and The Big A* are just three of the many products for the K-8 audience broadcast or delivered by satellite by Public Broadcasting Service (PBS) member stations. Some providers offer special events such as the Jason Project (see chapter 1, box 1-C), and continuing video seminars by working scientists who meet with students through the Talcott Mountain Science Center program, *On the Shoulders of Giants*. More and more activities are being directed to these students.

Educators

In addition to student needs, local school districts and States recognize the role of distance learning technologies for staff development programs and teacher inservice training. Often, teachers and administrators must travel hundreds of miles in order to attend classes, seminars, and workshops. The time, effort, and expense of travel limit opportunities for professional interaction. Just as distance learning offers a way to bring information, enrichment, and instruction to students, so can the needs of educators be served. In addition to video teleconferences, computer networks and computer conferencing give teachers and administrators a way to communicate with colleagues and obtain course materials. One of the largest of these is the Ag Ed Network, an agricultural database service that links schools in 18 States, and gives teachers access to more than 1,200 lessons and projects. Teachers using this service reach over 28,000 vocational-agricultural students in all 50 States. *14* Teachers in BIA schools receive staff development programming through the Eastern Navajo Agency Network. *15*

Many of the multistate video-based providers have extended their inservice training and staff development offerings dramatically in recent years. (See again table 2-1.) The effectiveness research on distance learning has concentrated on adult learners and training activities, and has shown that distance-delivered education is usually as effective as face-to-face instruction. Teachers and school personnel are well suited to distance learning. (Chapter 4 discusses in greater detail the uses of distance learning by and for teachers.)

Community Members

Telecommunications systems that link elementary and secondary schools during the day can serve other community members in the evenings and on weekends. Other communities of learners are reached through systems and programming provided by or through universities and other educational institutions (e.g., museums, libraries, and community centers). In rural communities, especially, the

*13*The Public Broadcasting Service (PBS) and their member stations have been providing instructional programming for all grades since PBS' feuding in 1969.

14 "Online Database Aid to Vo-Ag Education," *T.H.E. Journal*, vol. 16, No. 5, December/January 1988/1989, p. 38.

*15*The network is operated by the University of New Mexico's Center for Technology and Education under a contract with the Bureau of Indian Affairs. Paul Resta, director, Center for Technology and Education, University of New Mexico, personal communication, August 1989.

development of advanced telecommunications and information systems for both education and economic development are helping rural areas remain competitive with their more information-rich urban counterparts.

Kirkwood Community College in Iowa, besides providing high school and college credit courses, offers continuing education classes 2 evenings per week, and training for business and industry. Programming is determined by a local business advisory committee. The Kirkwood network has also been used for community service programs, such as updates by area legislators on State and Federal legislative issues, and information on crop diversification and financial planning for farmers.¹⁶

Some school districts and States have joined resources with universities, government bodies, and others when planning systems to share start-up and installation costs. Maine is installing a two-way video-based community college system utilizing the State universities, extension sites, and all the State high schools.¹⁷ Programming will originate from university sites for secondary, undergraduate, continuing, and vocational education; learners will be able to use the various downlink sites for multiple types of course offerings. (See chapter 5, box 5-A.)

What Is Being Delivered?

Whole Courses

The primary use of video-based distance learning technologies has been to provide courses not available to schools due to geographic isolation or other limitations. Most of the need is in foreign languages, mathematics and science, and humanities; table 2-2 lists some of the most frequently offered courses.¹⁸

Many classes and enrichment activities are videotaped, even if the students view the sessions live. The opportunity to review complicated material and ask further questions has proven valuable. The videocassette recorder (VCR) is a familiar technology to most teachers and is widely used in the

classroom. Although not part of the interactive environment per se, the VCR is a critical and ubiquitous element of technology in the classroom.¹⁹

Partial Course Materials

Students also receive "modules" or "units" that are integrated into the curriculum. For example, distance learning modules supported under the Technical Education Research Centers (TERC) Star Schools project encourage students to collect and analyze scientific data, and compare it with that gathered by students across the country. Topics include the study of radon, acid rain, and weather. The Jason Project developed mathematics, science, and social science curriculum for grades 4 to 12 to accompany the live exploration of the Mediterranean sea bottom. Partial course delivery is a promising area for innovation in distance learning. Reforms in science and mathematics education, particularly, call for more experiences for students with hands-on activities and cooperative learning; distance education may grow to meet these challenges.

Enrichment Materials

More and more students receive enrichment activities delivered by distance education technologies. These activities are generally one-time-only presentations designed to inform students (and teachers) on a particular topic. Some are live and interactive, although many schools tape such materials to use at their convenience. In 1989, the Satellite Educational Resources Consortium (SERC) offered six science, technology and society seminars to over 18,000 high school students. Public television stations and independent producers generate a large body of programs that are used as enrichment materials. The Telelearning Project takes its students on "electronic field trips," telephone conference calls to outside authorities, or other classrooms. (See chapter 1, box 1-B.)

¹⁶Rich Gross, dean of Telecommunications, Kirkwood Community College, "The Impact Of Educational Telecommunications-Some Observations," unpublished document, May 1989, pp. 3-4.

¹⁷University of Maine at Augusta, *Community College of Maine Newsletter*, vol. 1, No. 1, March 1989.

¹⁸The emphasis noted in table 2-2 is reinforced by a survey of representative districts conducted by Quality Education Data. In QED's survey of what whole courses were being offered in video-based distance learning systems, foreign language courses ranked first, followed by mathematics, social studies, computer sciences, and science. When QED's more detailed categories are combined to match table 2-2's breakdown, the figures are very comparable. Quality Education Data, op. cit., footnote 10.

¹⁹Quality Education Data reports that there are 191,000 VCRs in elementary and secondary schools in the United States, or 2.4 per school. Quality Education Data, Inc., 1989-90 *Catalog of Educational Mailing Lists and Marketing Services* (Denver, CO: 1989).

Table 2-2—Whole Courses Offered in the United States in 1988-89 by selected Distance learning Projects a

Foreign languages (119) ^b	Mathematics and science (11 O)	Humanities (69)	Political science and history (19)	Business and economics (16)	Vocational education (9)	Social studies (8)
Spanish (38)	calculus (17)	English (28)	History (11)	Accounting (8)	Shorthand (7)	Social studies (4)
French (26)	Mathematics (12)	Art/art history (7)	Law (5)	Economics (7)	Electronics (1)	Geography (2)
German (26)	Psychology/ sociology (12)	Composition (7)	Government/ politics (3)	Sales/marketing (1)	Home economics (1)	American studies (1)
Latin (12)	Science (11)	Literature (7)				Chinese culture (1)
Japanese (5)	Physics (9)	Communications (4)				
Greek (4)	Computers (6)	Humanities (4)				
Russian (4)	Trigonometry (6)	Education (3)				
Chinese (3)	Algebra (5)	Journalism/media (3)				
Italian (1)	Astronomy (4)	Theater arts (3)				
	Pre-calculus (4)	Music (2)				
	Statistics (4)	Philosophy (1)				
	Chemistry (3)					
	Health (3)					
	Technology (3)					
	Geology (2)					
	Anatomy (1)					
	Biology (1)					
	Biomedics (1)					
	Anthropology (1)					
	Elementary analysis (1)					
	Entomology (1)					
	Fish and wildlife (1)					
	Marine science (1)					
	Physical science(1)					

^a This table represents the total number of courses offered in the Sub@ listed in the distance learning projects in Appendix A. Note that these classes are not of equal size; each class could have from 12 to 1,200 students in it.

^b Numbers that appear in parenthesis represent the total number of courses offered under a general subject heading.

SOURCE: Office of Technology Assessment, 19S9.

Training and Staff Development

Teachers and educators are using distance learning systems installed in their schools and districts for seminars, college-level courses, workshops, and certification classes. Some school districts have made administrative and professional interaction the primary focus of their systems. The Los Angeles Educational Telecommunications Network (ETN), run by the Los Angeles County Office of Education, broadcasts exclusively staff development activities via satellite to most county schools. ETN has been a leader in statewide staff development efforts, which are critical to the curriculum reform effort in California. (See chapter 4, box 4-C.) Although few of the video-based systems are installed primarily to serve teachers and staff, almost all quickly see the utility of this technology for professional development. All the large providers have extensive offerings in staff development and inservice training.

Student and Professional Communications

Students and teachers using telecommunications technology can also reach outside information, people, and resources on their own. Students tap into databases, use homework hotlines, and participate in electronic conferencing with their peers. More than 6,000 schools have the modems necessary to communicate using computers.²⁰ AT&T's Long Distance Learning Network, in pilot projects, connects students in grades 3 to 12 in "Learning Circles," where they can discuss and learn about specific topics such as food, writing, and culture. The main thrust is to encourage students to work cooperatively on specific projects in key curriculum areas.²¹ Many other projects expand the opportunities for student communications with their peers. Videoconferencing and computer networking linked students from different countries in the Kids Interactive Telecommunications Project by Satellite. (See box 2-B.)

Teachers are using computer networks to increase professional contact with their peers, exchange

curriculum materials and classroom ideas, and access databases and information sources. Science teachers in New Jersey are using telecommunications to share resources and support. Teachers attend workshops every 6 weeks, and between workshops they use electronic mail and computer conferences to share curricular ideas and self-developed materials such as laboratory exercises and activity sheets.²²

How Are Educational Materials Being Delivered?

The primary use of the distance learning technologies available today has been to replicate the experience of face-to-face instruction. The characteristics of traditional instruction retained are instruction in the present (live), and teacher-student and student-student exchange (interaction). These qualities distinguish this application of educational technology from previous attempts, particularly educational television, where interactivity was virtually impossible.

Live experiences can heighten the interest of many students and sharpen the classroom activity by demanding that teacher and student be ready when programming begins. This demand of timeliness can also work as a disadvantage; for example, school districts' bell schedules often conflict. For programming across districts, this can be a significant sticking point.

Live With Interaction

Interacting with the teleteacher is the key ingredient in recreating the traditional instructional model. Whether live or delayed, interaction with the instructor is considered by many as a necessary condition for successful distance education.²³ In many of today's systems, interactivity between teacher and students is accomplished via telephone. The video image of the teacher is seen in the classroom, but the teacher cannot see the students in the respective classrooms; this arrangement is known as one-way video and two-way audio. Many of the larger

²⁰OTA, *op. cit.*, footnote 5, p. 192. It is unclear, however, how many of these modems are being used by students or for uses other than the administrative communication of data.

²¹Margaret Riel, "Cooperative Learning Across Classrooms in Electronic Learning Circles," paper presented at the American Educational Research Association Annual Meeting, San Francisco, CA, Mar. 27-31, 1989.

²²Howard Kimmel et al., "Computerized Collaboration: Taking Teachers Out Of Isolation," *Computing Teacher*, November 1987, vol. 15, No. 3, pp. 36-38.

²³See, for example, the OTACase studies of distance learning in Barker, *op. cit.*, footnote 6. See also Wagner, *op. cit.*, footnote 1; Bennett H. Berman, International Center for Information Technologies, Washington, DC, "Matching the Distance Learning Medium to the Message"; and Desmond Keegan, Kensington Park College, Adelaide, Australia, "A Theory for Distance Education From Peters to Peters," papers presented at the American Symposium on Research in Distance Education, Pennsylvania State University, July 24-27, 1988.

Box 2-B—Kids Interactive Telecommunications Project by Satellite

The 1986 Chernobyl nuclear accident may have been just a story on the news for American students, but for European young people living downwind of the disaster, it was a terrifying reality that meant contaminated fields and poisoned food. Many of these students remain skeptical about nuclear power. This is one of the lessons American eighth grade students learned when they talked live via satellite with students in Karlsruhe, West Germany. Thanks to a unique consortium involving public secondary schools, higher education, and private industry, on June 1, 1989 students from three Massachusetts middle schools met with their West German peers to discuss nuclear power, toxic waste disposal, alternative energy sources, rock and roll, and other global issues.

The 90-minute teleconference was the product of months of work and cooperation between the American schools, the University of Lowell, the Massachusetts Corporation for Educational Telecommunications (MCET), Massachusetts Educational Television, German educators, and the Digital Equipment Corp. (DEC). Together they formed a cooperative international telecommunications partnership, the Kids Interactive Telecommunications Project by Satellite (KITES).

KITES was launched by a professor at the University of Lowell. Through MCET he approached the manager of DEC's corporate video network with a proposal: "Why not use installed corporate telecommunications capacity to help kids explore important curricular content in a cross-cultural setting?"¹ DEC agreed to make available its two-way international network. DEC also loaned VT100 terminals and computers to the students and teachers in Lowell, Dracut, and Chelmsford schools, and to one of the German teachers, so they could communicate electronically throughout the school year prior to the broadcast.

Staff from the University of Lowell's College of Education worked with local teachers to develop curriculum and to offer training in the use of two-way television. To prepare for the international videoconference, KITES sponsored bi-weekly environmental science classes on the University's Instructional Network, a fully interactive two-way television facility that connects schools in seven towns to the four university campuses. The students wrote to their German peers. The American schools also took field trips to each of the other schools. Project staff found that the cultural stereotypes between the inner city, suburban, and rural schools were just as large as the stereotypes between American and West German students.²

The path from project startup to the June 1 teleconference was not a smooth one. The most serious problem centered on the lack of resources for curriculum development and training. Although the in-kind value of DEC's contribution, combined with personnel time from the university and other participating organizations, exceeded \$100,000, there were virtually no funds for teacher release time, materials, or consultant help. Support of this type is critical for long-term success.

When the day of the teleconference finally came, the serious moments were balanced with light ones. Students on both sides of the Atlantic started off a bit nervously, but quickly relaxed when the American side played a rap video, complete with a graffiti-ridden school yard setting and break dancing. The German group then played a video of their school's rock band, while the American host, a local television meteorologist, danced with a student to the universal language of rock. But serious discussion of issues dominated the teleconference, and the students' preparation on the topics of energy and the environment was evident in their questions to one another. Students learned that pollution problems are similar in both countries, citing too many cars and airplanes, not enough recycling, and pesticides as common problems. Still, when they took a straw vote for or against nuclear energy, the American students voted about 90 percent in favor; the German majority voted against, reflecting Chernobyl's impact.

Future videoconferences will explore other curriculum-related themes, expand the number of participating school sites through Massachusetts Educational Television facilities, and involve museums, libraries, and community centers as well. KITES also hopes to create links with other Western European, Asian, Eastern Block, and Third World nations. KITES's goal is to give students the tools and knowledge they need to communicate in the global community that they will inherit.

¹John LeBaron, coordinator and associate professor, Kids Interactive Telecommunications Project by Satellite, University of Lowell, MA, personal communication, July 1989.

²David Singer, "American and West German Students Trade Ideas Live," *Minuteman*, Bedford, MA, June 8, 1989, p. 9.

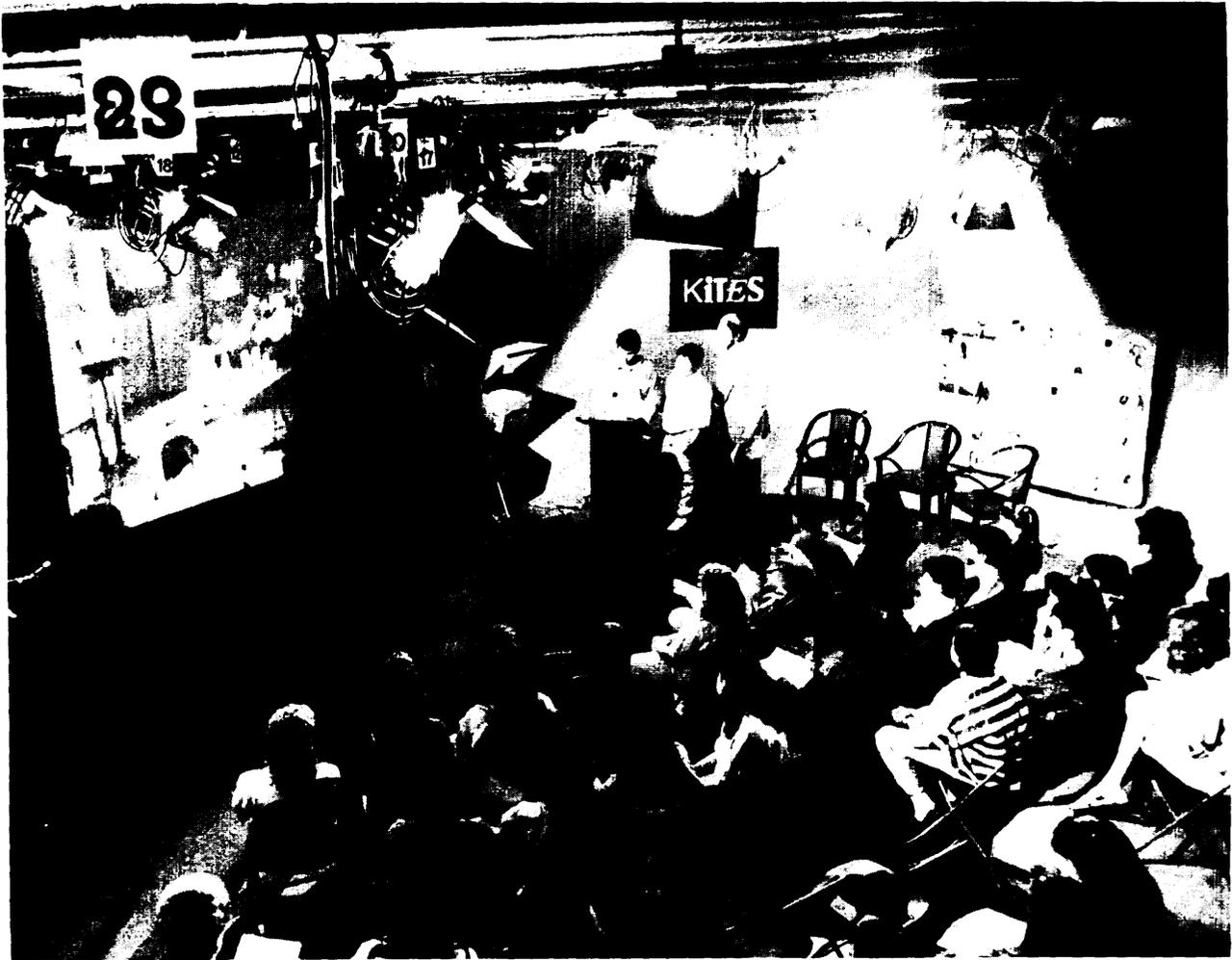


Photo credit: Hillary Levine, Beacon Communications Corp., Acton MA

Massachusetts students gather at Digital Equipment Corp.'s television studios to discuss global issues with their counterparts in Germany.

video-based providers are using this model, including Satellite Telecommunications Educational Programming (STEP), Oklahoma State University, and SERC.

Other systems add two-way video or graphics interactivity to the almost universal two-way audio. The Pennsylvania Teleteaching Project uses two-way computer hookups along with two-way audio to student-teach classes in North Dakota and other States. This audiographics system is a less expensive

alternative to video-based distance learning, which allows the teacher and student to converse through the computer keyboards as well as on the telephone line.

Two-way video, found usually in small, multidistrict systems, is the closest imitation of the traditional classroom that present technology allows. The Shar-Ed Video Network, linking four school districts in the Oklahoma Panhandle, is one example. (See box 2-C.) Minnesota has a number of systems

Box 2-C—Panhandle Shar-Ed Video Network

The Oklahoma Panhandle, a remote, sparsely populated area that inspired John Steinbeck's novel, *The Grapes of Wrath*, seems an unlikely site for a two-way, full-motion, state-of-the-art fiber optic television network. Nevertheless, this area, once described as "no man's land," illustrates how distance learning technologies can assist those schools most in need of resources, through cooperative efforts of local businesses and schools. The system allows districts to share teachers electronically and expand high school credit course offerings, provide inservice training to teachers, hold administrative meetings, and provide community education programs for local residents.

Located in the eastern end of the Panhandle, Beaver County includes four school districts that serve students spread over long distances. The Beaver School District has 519 K-12 students coming from a 426-square-mile area; Forgan has 191 students across 397 square-miles; Balko has 159 students across 305 square-miles; and Turpin has 420 students within a 303-square-mile area. The educational problems faced by Beaver County schools are typical of small, isolated school districts. It is almost impossible to offer advanced courses and specialized subjects on a regular basis. In the past, these kinds of courses, if offered at all, were provided in alternate years. In addition, low student enrollment made it prohibitively expensive for each school to employ a full-time certified instructor, even if one could be found. Attempts to fill the need with "circuit riding" or traveling teachers were not succeeding. Yet because of increased high school graduation requirements, higher college entrance requirements, demands for courses for gifted students, and needs to improve staff development, the superintendents agreed that new solutions were necessary. As the Forgan school superintendent explained: "Each of the districts in the area has a limited number of teachers and a rather restrictive curricula, and not enough State monies to rectify either of these two shortcomings. We had to look for new alternatives and for outside funding to help us."¹

Four years ago, Beaver County superintendents and school board members learned about distance learning projects in Wisconsin and Minnesota. They visited projects and hired consultants to analyze site and technical requirements, examine alternatives, and plan the system. The four districts, with support from the State Director of Rural Education, agreed to seek external funding for a two-way full-motion interactive television system for sharing instruction among their schools. They established the Panhandle Shar-Ed Video Network Cooperative, a partnership between the four school districts and Panhandle Telecommunications Systems, Inc., a subsidiary of Panhandle Telephone Cooperative Inc. (PTCI). PTCI is a co-op owned by 4,200 individuals in the three-county Panhandle region. According to Ron Strecker of PTCI, the Network is an important factor in keeping the schools open and in assuring the economic viability of the region.

These schools provide education to the children of our members. If any of the schools closed, we knew that PTCI would realize a loss in additional customers. So it was in our best interest to see that this did not occur. If any of the schools were to close then our communities would die. We wanted to keep these communities alive and this factor helped expedite our desire to participate in a joint project.²

To build their distance learning system, the four superintendents sought outside funding. Grants from the Oklahoma Board of Education, the State legislature, and the Oklahoma Department of Education (Office of Rural Education) totaled \$190,000. Two Oklahoma foundations contributed \$75,000 each. These funds (\$340,000) covered startup costs: installation of four-strand and eight-strand fiber optic cable between the four schools, the telecommunications hookups, and studio classroom equipment (cameras, television monitors, microphones, VCRs, and facsimile machines). They also covered costs of a 5-year lease of the fiber optic lines that are owned and operated by PTCI. Districts covered other remodeling costs, including the installation of observation booths so that students and teachers would not be disturbed by the onslaught of visitors expected. *(Continued on next page.)*

¹Doug Rundle, superintendent, Forgan School District, personal communication, in Bruce Barker, Texas Tech University. "Distance Learning Case Studies," OTA contractor report, June 1989.

²Ron Strecker, administrator, Panhandle Telephone Cooperative, Inc., personal communication, in Barker, op. cit., footnote 1.

that serve four to seven districts each with two-way video and audio. The capability to transmit signals from any of the sites in the system makes it possible to originate programming from any local site. In many of the Minnesota projects this is the case; each of the schools offers one class a day to students throughout the system.

Live With Limited or No Interaction

Materials that are broadcast or transmitted live, predominantly instructional programs on public television stations, are often recorded by teachers or schools for previewing before use in the classroom. Public broadcasting stations are a ubiquitous, expe-

In its first year (1988-89), the Shar-Ed Network offered four courses among the schools: Art History, Spanish, Advanced Placement English, and Accounting II (see figure 2-1). While many miles apart, classes operated as if students were side by side: the teacher and students in all sites could see and hear each other simultaneously. No class exceeded a total of 20 students, and each receiving class had a classroom facilitator appointed by the principal who served as proctor. Television teachers were given one additional preparation period. A 5-percent salary bonus is under consideration. Administrators, teachers, and students have been very positive about distance learning. Student achievement in courses has been high, and there have been other benefits as well.

Three years in the making, the Shar-Ed Network offers a way to expand resources for the districts yet maintain local control of curriculum, assure high-quality instruction, and keep the local school/community identity intact. The greatest tribute to the cooperative approach to the project is the fact that the four school districts have agreed on a common bell schedule to alleviate scheduling problems for the interactive video classes.

Future plans call for expanding the network to link the other eight school districts in the Panhandle and to connect Panhandle State University. With the addition of the university, college credit courses and other educational services will be offered for students, teachers, and members of the community.

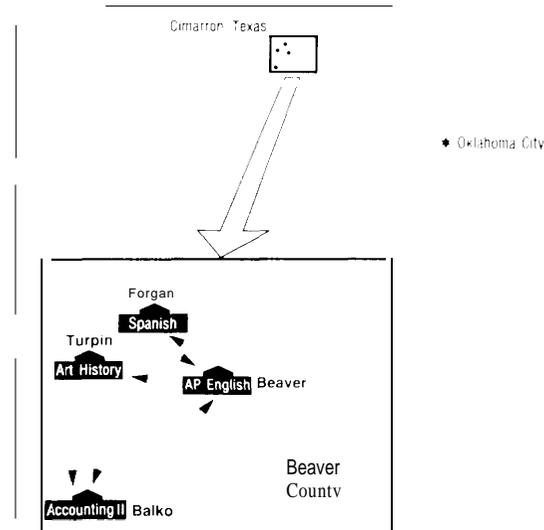
rienced source of instructional materials for K-12 classes.

Some of the distance learning systems have large classes or limited time for questions, which results in limited interactivity between students and teacher during the class time. Many of these providers offer "office hours" when students can call for help, or tutor time with the on-site teacher.

Computer Networks

Although computer conferences are live events, much of the activity on computer networks is on a delayed basis. Computer networks are being used in innovative ways for both student and teacher activities. To encourage a class of writing-resistant seventh graders, a teacher paired her class with a class of fourth graders in another school. The classes exchanged letters, and the big brother/sister relationships worked to encourage writing by the seventh graders.²⁴ In a corn growing contest between elementary school students in the United States and Canada, data on the height of the corn plants were sent through the network every 3 days. Students also used the network to ask scientists about farming strategies and to share results with these experts.²⁵ The Interactive Computer Simulations developed by the University of Michigan School of Education uses telecommunications to study public affairs, such as the Arab-Israeli conflict. The university and school facilitators guide the students through the month-long conflict simulation. Students at the sites send private diplomatic messages, press releases,

Figure 2-1—Panhandle Shar-Ed Video Network



Schools in the Shar-Ed fiber optic network send and receive courses, broadening the curriculum available to all students in Beaver County.

²⁴L. Schrum et al., "Today's Tools," *The Computing Teacher*, vol. 15, No. 8, May 1988, pp. 31-35.

²⁵Nancy Roberts et al., *Integrating Telecommunications Into Education* (Englewood Cliffs, NJ: Prentice-Hall, in press).



Photo credit: The University of Michigan College of Education

Students at two Michigan schools take on the role of Arabs and Israelis in an interactive computer simulation. They send diplomatic messages, hold meetings, and take political and military actions over the network.

take political and military actions, and hold meetings, all through the network.²⁶

Recorded Instructional Materials

Many materials are available only in recorded form. Audiovisual materials and filmstrips are older media technologies; interactive videodiscs are a fast-growing, emerging instructional technology. Together, this category represents the largest use of media technologies in education; almost all schools use tapes, films, filmstrips, or other media technology.²⁷ Such materials are widely used in both traditional and distance education classrooms.

Current Events Programming

National surveys have shown a startling lack of awareness on the part of secondary school students to politics, world events, and geography, among other subjects. In the 1989-90 school year, three news programs hoping to address this problem will begin programming specifically for schoolchildren. The Discovery Channel will offer *Assignment: Discovery*, in two, 25-minute segments each day.

Each day of the week will be dedicated to a different topic area.²⁸ Cable News Network (CNN) will produce *CNN Newsroom*, a 15-minute news and information program. Both cable-delivered programs will be available to any school that is wired for cable; three of the largest cable operators in the country have offered to wire schools in their service areas at no charge in conjunction with the CNN program.²⁹ Another company, Whittle Communications, is offering *Channel One*, a daily satellite-delivered news program. Two minutes of the 12-minute program will show commercials. In return for showing the program to students, the schools will receive a satellite dish, television sets, and other requisite equipment free of charge. The admission of advertising in public schools has generated a great deal of controversy in the educational community.³⁰

Who Are the Providers?

Telecommunications technologies make it possible to aggregate local, State, regional, and even national needs. This aggregation, and the expanding education and technology needs of

²⁶University of Michigan School of Education, Interactive Communication Simulations: *Inter-School Computer Mediated Learning Opportunities*, program information packet (Ann Arbor, MI: April 1989); and Edgar C. Taylor, Jr. and Frederick L. Goodman, "Computer-Mediated Simulations: The Global Classroom," *Academic Computing*, vol. 1, No. 1, spring 1987, pp. 52-56.

²⁷Over 86 percent of the elementary and secondary schools in the United States have at least one VHS VCR; over 50 percent have two or more. Quality Education Data, *Video Purchasing Patterns in Schools* (Denver, CO: May 1986).

²⁸The five subject areas are science and technology, social studies, natural sciences, arts and humanities, and world events and contemporary issues. Mark Walsh, "Discovery Cable Channel Plans Documentary Programs for School Use," *Education Week*, vol. 8, No. 35, May 24, 1989, p. 5.

²⁹"Turner to Launch 'CNN Newsroom' in High Schools," *Broadcasting*, vol. 116, No. 18, pp. 116-117.

³⁰See, for example, pro and con articles by William S. Rukeyser and Scott D. Thomson in *Education Week*, section on "On Commercial Television in Schools," vol. 8, No. 26, Mar. 22, 1989, pp. 23, 25. Also, see Joe Sharkey, "Whittle Sweetens Schoolroom TV Plan to Blunt Criticism of News. Ad Format," *The Wall Street Journal*, June 9, 1989, p. B3; and "In School: Subsidized News Is Worth a Test," *The New York Times*, editorial, Mar. 12, 1989, p. E24.

schools, has brought a widening array of providers to the education market. Many of these providers are members of the traditional public education community, while others are from the private sector. They supply the K-12 community with a variety of programming, services, and hardware. Teachers and outside experts can be provided by other districts, the higher education community, or the private sector. Hardware and software companies offer programming and technical assistance. Public and commercial broadcasting stations, cable and local instructional television systems, and local or regional telephone companies and satellite distributors can provide the means to connect different sites. Although most schools will continue to offer much of their own instruction, many are likely to turn to outside suppliers to obtain educational and telecommunications resources.

Local School Districts

Many K-12 distance learning projects are locally based. Local networks enable schools to pool students and teachers, and to maintain the traditional involvement and control of local interests in public education. In Minnesota, two-way interactive video via microwave, cable television, Instructional Television Fixed Service (ITFS), or fiber optic cable links districts with one another; by the 1989-90 school year, one-third of all school districts in the State will be served by some form of distance learning. Many sites do not have a teacher, facilitator, or any adult monitor in the remote teaching classrooms. A school district in Louisiana uses fiber optics to connect parochial school students to instructional programming provided by the public school's Integrated Learning System.³¹ The Bismarck, North Dakota school district (the largest district in the State) originates Spanish instruction for six small rural schools through a network of computers and simultaneous telephone conferences. Each small school pays part of the salary of the teacher in the host school.

The great appeal of local distance learning projects is community control over curriculum and instruction. Each district or area uses its own teachers, and structures courses and other activities to meet community needs and fit local standards. For many, these are important qualities that larger national projects lack. However, the quality of some

local efforts is restricted by the availability of teachers willing and well suited to teach over these systems. Some projects are undertaken without appropriate teacher training or attention to production quality; distance learning can then fall short of its potential.

Regional Education Service Agencies

Regional education service agencies exist in almost every State and function to pool local school districts' resources to address common needs. Many local districts have used these agencies to provide distance education technology and programming. The STEP network in Washington State and the Telelearning Project in New York State (see chapter 1, boxes 1-A and 1-B, respectively) are both examples of curriculum provision by regional education service agencies. In Connecticut, the Area Cooperative Educational Services distance learning consortium brings together students from Amity, Hamden, Cheshire, New Haven, and North Haven high schools. Fiber optics link the sites; students are offered 14 different classes via two-way video and audio transmission. Providing Academics Cost Effectively (PACE) is a cooperative interactive television effort spearheaded by the Cheboygan-Otsego-Presque Isle Intermediate School District (ISD) in northern Michigan. Expansion plans (using fiber, ITFS, and cable) to reach all districts within the ISD, and the Charlevoix-Emmet ISD, are under way.³² Like local school district projects noted above, distance learning efforts produced by regional education service agencies are positioned to be particularly responsive to local needs and interests.

States

The State role in K-12 distance education is critical in developing infrastructure, providing funding for projects, and promulgating policies and regulations guiding development for distance learning programming. (See chapter 5.) Few States are providing programming for students; more are using their statewide systems to deliver teacher training. North Carolina, for example, produced short courses and full courses for their teachers. (See chapter 5, box 5-A.) Kentucky is presently constructing a statewide satellite system, with a downlink at each of the more than 1,300 elementary and secondary schools in the State.

³¹Angela Mielke et al., "Teaching at the Speed of Light; The Fiber-Optic Connection," *T.H.E. Journal*, vol. 16, No. 8, April 1989, pp. 77-78.

³²Cheboygan-Otsego-Presque Isle Intermediate School District, "PACE information Manual," unpublished document, Jan. 1, 1989.



Photo credit: KLCS-Channel 58, LA Unified School District

The Los Angeles Unified School District offers a Homework Hotline over its educational television station. After school, students call in questions and get to see their problems solved during the broadcast.

Higher Education

School districts can also turn to local institutions of higher education for programming and telecommunications resources. In many cases, colleges and universities have instructional and technology resources that schools can use. The opportunity for these institutions to expand revenues and make greater use of existing resources has led to some cooperative arrangements with local districts as well as with multistate or national projects, such as the Star Schools projects.

The Rochester Institute of Technology in New York State uses audiographics and other technologies to bring its instructors to local schools that pool money to pay the professors' salaries. Some of these

classes are dual credit classes, allowing students to receive college credit while still in high school.³³ Western Montana College created the Big Sky Telegraph Network, a computer network linking 114 one-room schools, librarians, and others throughout the State. Teachers share ideas, answer questions, request software and library books, and take classes over the network; students and economic development specialists are also using the system.

Colleges and universities see these arrangements as an effective way to recruit students to the institution and to increase the preparedness of new students. The benefits for local schools include access to a wider array of educational and technical resources, including experts in various fields of

³³Susan M. Rogers, director, Distance Learning Projects, Rochester Institute of Technology, personal communication, April 1989.

study, and a greater breadth and depth of educational materials.

Public Television

PBS and public television stations around the country reach 94 percent of American households and can be received by schools that serve 29 million students.³⁴ Since its inception in 1969, PBS has been broadcasting and delivering by satellite enrichment programming, teacher teleconferences, documentaries, and one-way courses to schools. Familiar fare, such as *Sesame Street* and *3-2-1 Con/act*, is regularly incorporated into classroom instruction; *Nova* and *National Geographic Specials*, among other documentary programming, are also used by teachers throughout the country. PBS often provides print and other support materials to accompany its educational programming. Teachers can expand their science curriculum by using *The Voyage of the Mimi* series and accompanying text and software in secondary school science classes.³⁵ Professional development programming has been greatly expanded in recent years; many live teleconferences are held each year, and PBS' Education Clearinghouse offers professional development video programs through "Video File."³⁶

Future PBS education-related efforts include the "Education Pipeline," a project being tested that will deliver via satellite educational software, text, and teacher guides and handouts that accompany instructional programming. PBS also offers an extensive range of one-way live courses for college credit through the Adult Learning Service.

Individual public television stations are also involved in distance education. WHRO, a public television station in Norfolk, Virginia, has extensive telecommunications facilities including satellite uplinks and downlinks, microwave connections to other public television stations around the State, and an ITFS system that transmits distance education programming to local schools. Nearby, Old Dominion University (ODU) provides programs from its

three electronic classrooms to the WHRO network.³⁷ ODU also produced the three-part *USA-USSR Youth Summit Teleconference* Series, including one international teleconference between American and Soviet teenagers. Organized to support international studies curricula for grades 7 to 12, this teleconference was carried by 155 PBS-member stations.³⁸

Public television stations and PBS provide a significant resource for education in this country today. Because of their national focus, and their investment in and commitment to broadcast technologies, PBS will continue to offer predominantly one-way programming, both live and delayed. The ubiquity of the public television and public radio networks makes them valuable educational providers.

Other Educational Institutions

Other institutions with public and educational outreach responsibilities are involved in distance learning. These include museums, laboratories, science centers, and agencies of the Federal Government. The Talcott Mountain Science Center (Connecticut) Sci-STAR satellite program reaches students and teachers in 30 States. The series brings experts in such fields as superconductivity and planetary exploration into the classroom electronically, allowing students at remote sites to watch live experiments, ask questions, and conduct their own followup activities inspired by the example of these working scientists. The National Aeronautics and Space Administration, long a pioneer in distance education, currently produces four teleconferences a year for teachers on current issues and suggested activities related to space science.

A Note on Provision of Content v. Delivery of Content

In any discussion of providers, especially commercial providers, it is important to distinguish between content for classrooms and services to deliver that content. Many organizations that deliver an electronic signal to the school do not take part in

³⁴U.S. Department of Commerce, National Telecommunications and Information Administration, *Public Broadcasting Coverage in the United States* (Washington, DC: U.S. Government Printing Office, July 1989).

³⁵Dec Brock, senior vice president, Education Services, Public Broadcasting Service (PBS), personal communication, July 1989. *The Voyage of the Mimi* is a widely acclaimed series targeted to grades four to eight, produced by the Bank Street College of Education. PBS does not produce any programs itself; it obtains and distributes programs from public television stations, independent producers, international sources, and others. Public Broadcasting Service, "The Voyage of the Mimi," fact sheet, 1988; and Public Broadcasting Service, "Facts About PBS," unpublished document, January 1988.

³⁶Public Broadcasting Service, "Elementary/Secondary Service Newsletter," January, July, and September 1989.

³⁷OTA sit visit, March 1989.

³⁸Chet Tomczyk, Elementary/Secondary Service, Public Broadcasting Service, personal communication, July 1989.

the programming. These include satellite systems (satellite owners such as GTE and Hughes), cable television systems (numerous cable operators around the country who provide channels for schools to use), and telephone providers (local, independent, and long distance telephone companies). Many of the providers discussed in the preceding paragraphs—local school districts, States, higher education institutions—provide the course content, and then contract with one of these service providers to transmit their materials to the schools.

In contrast, other providers control both content and delivery method. ITFS licenses, for example, are reserved for educational institutions; therefore, in most ITFS systems the educational entity creates and delivers the instruction.

The trend is toward combining content and delivery. Companies previously serving as delivery vendors, such as satellite owner Hughes Aircraft and phone companies NYNEX and US West, are attempting to become content providers.³⁹ Cable providers such as The Learning Channel and Mind Extension University create some of the educational material and control part of the delivery of that material; satellite providers like Oklahoma State University and TI-IN Network do the same. The distinction does, however, represent two ends of the spectrum of offerings.

Commercial Providers

Private sector involvement is increasing rapidly, due to many factors. Companies want to expand their markets, improve the quality of education of their future workers, improve curriculum choices and quality, and expand delivery of their services. Commercial providers supply programming, equipment, and technical expertise, although providing content is prohibited in some cases.⁴⁰ Some companies (for example, some cable television operators) are involved in the production as well as the distribution of education materials.

Satellite—one of the first private companies to offer courses to local schools was the TI-IN Network. Started in 1986 through a cooperative arrangement with Texas' Education Service Center, Region 20, TI-IN currently offers 25 courses via satellite to over 4,000 students at 780 schools in 32 States. PBS maintains dedicated transponders on a commercial satellite, and transmits hundreds of hours of programming to schools every month.

Cable—There has been a recent flurry of interest in educational programming in the cable industry; several individual cable companies are developing programming to meet educational needs. The Learning Channel, in existence since 1980, produces a wide range of programming for high school and college students, adults, and teachers. Available to an estimated 20,000 schools and 17 million households through cable television, The Learning Channel offers many complete mathematics, science, and literacy courses for secondary school students, college credit courses in many subjects, and seminars on topics such as AIDS and education. Mind Extension University, launched in late 1987, is a cable television channel dedicated to educational programming. Several cable companies have formed the Alliance for Cable Education, to better serve this expanding marketplace. Although cable installation extends to over 80 percent of the country, school access is still quite limited, and this will be one area of concern addressed by the Alliance.⁴¹

Public Telephone Network—Local and regional telephone companies serve distance education through the transmission of voice, graphics, and data over the public network, and the management of dedicated (private) networks for video which are carried through public facilities. Local and regional telephone companies are prohibited from delivering video over the public network at this time because of restrictions resulting from the Cable Act of 1984.

Computer network projects such as the Physics Forum in Massachusetts⁴² and audiographics proj-

³⁹Hughes Aircraft is considering a plan to provide programming to grades three to five in inner-city schools via satellite. Norman Avrech, Space and Communications Group, Hughes Aircraft Co., personal communication, September 1989. The telephone companies are actively working to remove the restrictions that prohibit them from providing video on the public network.

⁴⁰Ibid.

⁴¹Access to cable services can mean many things. "Sometimes it means a cable drop has been made near or at the school door, sometimes it means a cable is in the vicinity but not at the school property, and frequently it means the school has been wired but the wire runs to one room, such as a library or office, and access to the room isn't easy." Lyle Hamilton, manager, Broadcast Services, National Education Association, personal communication, Aug. 21, 1989. Even with access, schools may be limited in their use of cable or other video programming by shortages of television sets and VCRs.

⁴²The Physics Forum is a network for physics teachers in Massachusetts where teachers can exchange lesson ideas, hold conferences, tap into test banks, and download public domain software. Tom Vaughn, "Don't Be Isolated: Telecommunicate," *On Cue*, vol. 1, No. 3, March 1988, pp. 11, 14.

ects, such as the Delaware-Chenango Board of Cooperative Educational Services (BOCES) Tele-learning Project, use public phone lines to carry voice, data, and graphics. Telephone companies have also worked with educational institutions to provide telephone lines for video-based distance learning. For example, the Long Island BOCES project uses a fiber optic private network to provide two-way video and audio; the fiber optic cables used are leased from New York Telephone and dedicated to the BOCES project.

Hybrid Organizations and Consortia

Many distance education providers are really combinations of the types mentioned above. The Star Schools projects, for example, are required to build consortia that bring together local education agencies, State departments of education, institutions of higher education, public television stations, and/or private and nonprofit entities. Some or all of the members of the consortia provide programming for the network as a whole. (See chapter 6 for a description of the four Star Schools projects.) Also, numerous distance learning systems are run for the benefit of different communities of users. The Vermont Interactive Television (VIT) project is a joint venture of the Vermont State Colleges, Vermont Department of Education, Vermont Agency of Economic Development and Community Affairs, Vermont Department of Employment and Training, North Country Area Vocational Center, and New England Telephone. VIT is gradually expanding after a successful demonstration year to serve the videoconference, training, and instructional needs of State agencies, business and industry, vocational schools, primary and secondary schools, and higher education.⁴³

A Note on Institutional Relationships in Distance Learning

Distance learning has fostered many new institutional arrangements for the provision of curriculum and instructional services. Reasons for this include the large start-up costs needed to implement many systems. Such costs drive districts and providers to seek out others to create economies of scale. Second, institutions and people with prior experience in distance education are usually outside of the elementary and secondary schools. Most often, com-

munity colleges, universities, business users, and business providers are the local or regional experts in distance learning provision. Third, the wide number of technologies available has brought many technology providers, as well as many content providers associated with a particular technology (e.g., cable television) to the education doorstep. Lastly, demands for telecommunications networks have emerged in other segments of the community. Education has been able to forge partnerships with governments, the business community, and others with convergent needs; such partnerships can significantly reduce the costs of information highways to all.

New institutional connections expand the domain of colleagues and institutional expertise available to classroom teachers and local school districts. New resources flow into a school via distance learning. Greater community involvement and commitment can be secondary outcomes of expanded roles for other players in the schools.

These very same connections can also create significant tensions. Control issues arise along two dimensions: control of the content and processes of instruction, and control over the telecommunications resources necessary for delivery. In the area of education policy, issues of certification and local v. State control of curriculum become important. Business or other groups outside of education may expect more say in how the shared resources are used in the schools than the local education authority deems appropriate. In the telecommunications arena, the needs and concerns of the education community may be far from the prime concern of policymakers. In both arenas, **educational leadership in planning, goal setting, and allocation of resources will ultimately determine the quality and availability of distance learning.**

How Are Distance Learning Systems Being Paid For?

Funding solutions for distance education are as varied as technical solutions. Arizona, for example, issued bonds to cover construction costs. The Kentucky legislature voted \$11.3 million to install satellite dishes on every school in the State, while the Iowa legislature authorized \$50 million for the construction of that State's educational telecommu-

⁴³Vermont State Colleges, "Vermont Interactive Television Evaluation Report," unpublished document, Sept. 27, 1988. By 1992, Vermont Interactive Television plans call for 90 percent of the population of the State to be within 25 miles of a transmission site.



Photo credit: *Apple Classroom of Tomorrow, Nashville, TN*

Do students learn? More research is needed, but evaluations to date have been encouraging.

nications system. (See chapter 1, box 1-A.) The State of Connecticut has a grant program for local projects. (See chapter 5, box 5-B.) One of the more innovative funding solutions is Missouri's tax on videotape rentals; revenues are expected to reach \$5 million in the first year of the tax.

For small school districts, the question of funding is especially critical. A high school with only 90 or 100 students cannot afford the thousands of dollars it may take to get an effective distance learning project into place. In some cases, districts who need the systems the most are least able to afford them, and outside assistance is required to provide any educational services via distance learning.

*Is Distance Learning Effective?*⁴⁴

Much of the research on distance learning evaluates its effectiveness in higher education and business. **This effectiveness literature has been quite consistent: when used in business, military training, and adult learning, there is no significant difference in effectiveness between distance learning and traditional instruction methods, and student attitudes are generally positive about the experience.**⁴⁵

This conclusion, however, does not necessarily extend to the K-12 setting. Little research exists that specifically addresses K-12 distance education, and

⁴⁴This section of the report draws heavily on Moore, *op. cit.*, footnote 2.

⁴⁵*Ibid.*, p. 7.

what does exist is limited in scope and often anecdotal. Few long-term evaluations have been conducted, partly due to the newness of many systems. One review of the literature, for example, found 503 documents that related to distance education, of which only 46 examined K-12 applications. In addition, there were “. . . no studies comparing effectiveness of instruction across types of population (general K-12, exceptional students), no effectiveness data comparing different content areas, and none comparing the effectiveness of instruction using different instructional designs.”⁴⁶ The literature regarding the effectiveness of teacher inservice and staff development is similarly lacking.⁴⁷ The literature that is available, however, is enlightening for the present and suggests future directions for research and evaluation in the field.

Effectiveness Studies- A Look at the Literature

Video-based interactive instruction is the distance learning format that most closely resembles the traditional classroom. This has been the format of choice for many distance learning systems. The primary effectiveness question asked, then, about video-based, interactive distance learning is: “Do students learn as much through distance learning as through face-to-face instruction?” There are, however, other important considerations that go into assessing the overall effectiveness of learning systems. Some of these outcomes include:

- learner achievement (the above-noted “primary” question),
- . learner perceptions and attitudes,
- course and curriculum design considerations,

- . inservice training effectiveness, and
- cost-effectiveness.

Learner **achievement is the** primary question asked about distance learning: “Do the students learn as much through distance learning as their counterparts in traditional classrooms?” One survey of K-12 and adult distance education literature suggests that students learn as well in distance education programs as they do in regular programs.⁴⁸ Iowa’s two-way interactive television (TWIT) project found no significant differences between these classes and other sections of the same class taught face-to-face by the same teachers. Daily lesson scores, test scores, grades, and levels of participation were comparable for the two groups.⁴⁹ Similarly, a wide range of elective programming provided from 1983 to 1986 in rural Minnesota showed no statistically significant differences in achievement by the distant learning students compared to students in a traditional class.⁵⁰ A much longer list of evaluations of adult learners indicates that delivery of educational programming via teleconferencing is educationally effective.⁵¹

Research has also sought to understand learner perceptions and **attitudes** in three areas: assessing learner satisfaction with the course; discovering perceptions of the technologies’ effect on the instructor/student interaction; and examining student perceptions of teaching methods. Two surveys of K-12 project evaluations reported generally positive student attitudes.⁵² In one example, the Iowa TWIT system reported very positive results: 97 percent indicated no more problems in the televised classes than in traditional classes, and 67 percent thought students accepted more responsibility for their behavior and learning in televised classes.⁵³ However, a survey of an early satellite project was

⁴⁶William D. Eiserman and David D. Williams, *Statewide Evaluation Report on Productivity Project Studies Related to Improved Use of Technology to Extend Educational Programs. Sub-Report Two: Distance Education in Elementary and Secondary Schools. A Review of the Literature*, ERIC, ED 291350 (Logan, UT: Wasatch Institute for Research and Evaluation, 1987).

⁴⁷Moore, op. cit., footnote 2, p. 21.

⁴⁸Anne Batey and Richard N. Cowell, *Distance Education: An Overview*, ERIC, ED 278 519 (Portland, OR: Northwest Regional Educational Laboratory, 1986).

⁴⁹Robert N. Nelson, “Two-Way Microwave Transmission Consolidate Improves Education,” *NASSP Bulletin*, vol. 69, No. 484, 1985, pp. 38-42.

⁵⁰Will Kitchen, “Education and Telecommunications: Partners in Progress,” ERIC, ED 282551, testimony before the Senate Committee on Labor and Human Resources, Mar. 11, 1987.

⁵¹Moore, op. cit., footnote 2, pp. 9-12.

⁵²D. William Quinn and David D. Williams, *Statewide Evaluation Report on Productivity Project Studies Related to Improved Use of Technology to Extend Educational Programs. Sub-Report Three Survey of Technology Projects Throughout the United States*, ERIC, ED 291351 (Logan, UT: Wasatch Institute for Research and Development, 1987); and Batey and Cowell, op. cit., footnote 48.

⁵³Nelson, op. cit., footnote 49.

generally negative: 65 percent believed their televised class to be more difficult than their regular classes, and almost 70 percent said they would choose a traditional course over a satellite course.⁵⁴

Many studies of adult learners indicate generally positive attitudes toward telecommunications instruction.⁵⁵ One study looked at student perceptions of teaching behaviors necessary for effective instruction in both conventional and teleconferencing instruction. This study found five statistically significant factors in effective teleteaching: effective teleteachers used students' names, set out clear statements of purpose, made use of printed material, encouraged discussion, and did not speak in a monotone.⁵⁶

Research in effective **course and curriculum design** has focused on overcoming the differences between the distant and local classrooms. One study introduced the concept of "teletechniques," a set of components taken for granted in face-to-face instruction but not automatically found in distance education. These components include the need to humanize the teaching experience (create rapport with students); encourage participation (ensure interaction between students, and between students and teacher); attend to message style (vary tone of voice and volume, using videos and other visual aids); and provide regular feedback (monitor student interest).⁵⁷ Other researchers have applied these criteria to effectiveness studies.⁵⁸

Inservice training is widely offered via telecommunications. Effectiveness research has been very limited, but is generally positive. One study of teachers being retrained in mathematics instruction

found the remote learners doing better than the face-to-face group.⁵⁹ Another controlled study found that while a majority of teachers felt the teleconferencing instruction was either acceptable or preferable, a substantial minority felt it was an undesirable method. Both the face-to-face learners and the distant learners in this study rated the instruction equally effective.⁶⁰ Distance delivery of inservice training, like other forms of training for audiences of professionals, is likely to be effective if designed well. The literature does not appear to fully address special needs of this group of learners. Research questions in the future may include attitude questions, such as whether an audience of teachers is inherently critical of such instruction (or more inclined to react favorably), or whether such an audience feels particularly threatened by the technology.

Assessing **cost-effectiveness** of distance education is difficult. Many of the benefits of distance learning, such as increasing parental and community involvement in the schools and exposing students and teachers to new technologies, cannot be quantified. Such an analysis requires some comparison with another delivery method; many distance education projects exist precisely because there is no other method available. Attempting to establish cost-effectiveness begs many questions about what constitutes effective education, and what value to place on results.

Some economic models have been devised that attempt to analyze costs associated with distance learning. Most of these models analyze costs in

⁵⁴Bruce O. Barker, "The Effects of Learning by Satellite on Rural Schools," ERIC, ED 284 693, paper presented at the Learning by Satellite Conference, Tulsa, OK, Apr. 12-14, 1987.

⁵⁵J. J. Boswell et al., "Telelecture: An Experiment in Remote Teaching," *Adult Leadership*, vol. 16, No. 9, 1968, pp. 321-322, 338; D. P. Hoyt and D. Frye, Kansas State University, "The Effectiveness of Telecommunications as an Educational Delivery System," unpublished manuscript, ERIC, ED 070 318, 1972; G. R. Christopher, "The Air Force Institute of Technology-The Air Force Reaches Out Through Media: An Update," *Teleconferencing and Electronic Communications*, L. Parker and C. Olgren (eds.) (Madison, WI: University of Wisconsin-Extension, Center for Interactive Programs, 1982), pp. 343-344; and J. Kruh, "Student Evaluation of Instructional Teleconferencing," *Teleconferencing and Electronic Communications II*, 1983, pp. 293-301.

⁵⁶B. A. Haaland and W. G. Newby, "Student perception of Effective Teaching Behaviors: An Examination of Conventional and Teleconference Based Instruction," *Teleconferencing and Electronic Communications III*, 1984, pp. 211-217.

⁵⁷L. Parker and M. Monson, "Teletechniques: An Instructional MO&I for Interactive Teleconferencing," *The Directional Design Library*, vol. 38 (Englewood Cliffs, NJ: Educational Technology Publications, 1980).

⁵⁸Jocelyn A. Hezekiah, "Teletechniques: A Case Study in Implementation and Evaluation," *Teleconferencing and Electronic Communications V*, 1986.

⁵⁹B. G. Nunley, University of Texas, "A Study of the Effectiveness of Telelecture in the Retraining of Elementary Teachers in Mathematics," unpublished doctoral dissertation, 1965.

⁶⁰Joseph M. Kirman and Jack Goldberg, "One Way Television With Simultaneous Telephone Group Conferencing Using Satellite Maps as a Monitoring Device," A Report to the Innovative Projects Fund, ERIC, ED 224460, 1980.

business, higher education, and inservice training.⁶¹ One suggested approach for K-12 distance education is the "ingredients method." This method involves the identification and specification of all relevant inputs; a typical list of ingredients would begin with personnel, facilities, equipment and materials, and in-kind contributions from participating sites.⁶³

Effectiveness Studies- A Look at Ongoing Projects

The research literature provides one look at evaluation efforts going on in distance education today. Perhaps more useful is a snapshot of current projects, several of which are generating unpublished surveys and project evaluations that are providing current, localized feedback.⁶⁴ Examples of these unpublished surveys show how existing efforts are monitoring and correcting their course.

A pilot project in Texas evaluated three different "telecourse" delivery efforts in the State. This project had as its goal the development of evaluation standards for the future.⁶⁵ Both student test results and participant reactions were monitored. Student test results in the telecourses were equal to or better than their counterparts in traditional classes, but their perceptions were different. Telecourse students rated their courses as harder, felt they learned less, felt that asking questions was more difficult, and said they needed teacher conferences more often.

Minnesota conducted a study of the State Technology Demonstration Sites; these are a number of small projects grouping schools in a single district or across districts, using multiple technologies for two-way instruction which they call "Interactive Television" (ITV).⁶⁶ The study analyzed effects on

students (attitude, achievement, classroom climate and interaction), on teachers, and on the districts. Costs were identified, but the evaluation did not address issues of cost-effectiveness ". . . given the difficulties associated with fair comparisons of costs incurred in ITV programs and costs incurred in traditional forms of schooling."⁶⁷

Student attitudes were generally favorable after an initial adjustment. Only 30 percent of the students took ITV classes because that was the only way to take the class. Of the students who dropped out of the ITV classes, 55 percent indicated that television influenced that decision; however, just over 50 percent of the students dropping these classes said they would take another ITV class. Achievement data overall showed no significant difference for the student population at large. Classroom interactions were measured and reported in this study, and showed no difference between ITV and traditional classes. ITV magnifies several things ("dead" time, personal and teaching styles, effectiveness of a good teacher and weakness of a poor one) but those teachers who were highly interactive and involving in traditional classrooms were equally successful on ITV.

Teacher attitudes were generally favorable toward ITV; 75 percent said they would choose to teach again on the system. Seventy percent of those teachers surveyed believed teaching on ITV required them to change their style or method of teaching, which was seen as both a problem and an opportunity. Teachers believed their students liked the ITV classes, spent as much time on task, and were frequently more motivated than traditional class students. Surveyed teachers noted that ITV chal-

⁶¹Sarah Rule et al., "An Economic Analysis of Inservice Teacher Training," *The American Journal of Distance Education*, vol. 2, No. 2, 1988, pp. 12-22; Alan G. Chute and Lee Balthazar, *An Overview of Research and Development Projects at the AT&T National Teletraining Center* (Cincinnati, OH: AT&T National Teletraining Center, 1988), p. 4; Hal Markowitz, "Financial Decision Making < calculating the Costs of Distance Education," *Distance Education*, vol. 8, No. 2, 1987; R.G. Showalter, *Speaker Telephone Continuing Education for School Personnel Serving Handicapped Children: Final Project Report 1981-82*, ERIC, ED 231150 (Indianapolis, IN: Indiana State Department of Public Instruction, Indianapolis Division of Special Education, 1983); Christopher, op. cit., footnote 55.

⁶²Richard Clark, University of Southern California, "Evacuating Distance Learning Technology," OTA contractor report, May 1989, pp. 20-24.

⁶³Henry Levin, *Cost Effectiveness: A Primer* (Beverly Hills, CA: Sage Publications, 1983); and Henry H. Levin, Stanford University, "The Economics of Computer-Assisted Instruction," unpublished manuscript, May 1988, p. 3. For a broader discussion of cost-effectiveness, see OTA, op. cit., footnote 5, pp. 74-83.

⁶⁴A look at the list of distance learning projects in this report (app. A), reveals a limited number of these evaluative efforts to date. Most resources are being committed to immediate implementation of systems, e.g., hardware purchases and teacher training. One explanation for this is that the needs being served by these systems are pressing, creating a strong action agenda.

⁶⁵The three projects studied included a videotaped Spanish course, interactive courses offered via satellite statewide, and interactive courses offered via microwave region-wide. Texas Education Agency, "Serving the Needs of Telecourse Students: A Pilot Project to Develop Evaluation Guidelines," unpublished document, 1986.

⁶⁶Diane L. Morehouse et al., "Interactive Television: Findings, Issues and Recommendations," unpublished document, Feb. 1, 1987.

⁶⁷Ibid., p. 7.



Photo Credit: Louisiana Educational Resources Network, Southern University--Shreveport

When they are involved in distance learning activities, students learn to manipulate the tools of the information age.

lenges teachers to grow, and enlarges options for students. Teachers also felt that discipline problems were greater in ITV,⁶⁸ movement was restricted in the classroom because of the cameras, and technical problems were an obstacle.

SERC, one of the four Star Schools Program grantees, will be offering high school courses and staff development courses during the 1989-90 school year to students in 22 States via satellite. During the second semester of 1988-89, SERC conducted pilot classes for high school students and teachers. Two high school classes were offered, with enrollments of 160 and 204 students, an average of three to four students per school. An independent evaluation study was undertaken to profile the population taking the classes, determine the effectiveness of the classes and the technology that supported it, compare participants' attitudes before

and after the semester, and compare interactive satellite delivery with traditional instruction.⁶⁹

Many observations were recorded by this survey; a few are detailed here. Although all classes were recorded and made available to students, and although many students complained that the class continued to be transmitted during vacation times, more than one-third of the high school students never borrowed a tape for review. Only 40 percent of the high school students felt there was sufficient opportunity to interact with the teacher. The students overwhelmingly approved of the opportunity to take classes otherwise not available, and two-thirds would take another class via interactive television.

Facilitators in the remote classrooms were surveyed, and reported that motivating students and helping students with content questions were their primary duties. Only three of five facilitators felt

⁶⁸Most of the classes had no facilitator or other adult in the receiving classrooms. *Ibid.*, p. 2.

⁶⁹Toby Levine Communications, Inc., "SERC Pilot Semester Evaluation Project," vol. 1, unpublished document, July 1989.

prepared to answer student questions. Facilitators spent 6 to 10 hours a week on SERC responsibilities, and felt the training sessions, handbook, and hotline provided by SERC to be helpful. Twenty-five percent of the facilitators felt that interactive television was not as effective as regular instruction, although almost all felt the students received excellent instruction. More than 80 percent of them would be willing to serve as facilitators again.⁷⁰

Participant reactions such as those noted in the above examples provide much useful information. It is from participant reaction data that most unanticipated problems and benefits are uncovered. For example, the InterAct Instructional Television Network in Houston discovered that students in small rooms were helping each other a great deal while the teacher was talking. They could do this without disrupting the teacher or the other students, and could prepare responses and then activate the microphone to join into the discussion or answer a question. Some of the tutors hired to supervise the rooms were discouraging this behavior, assuming that talking indicated a discipline problem. Training the tutors to encourage this cooperative learning method is an easy correction resulting from this participant survey.⁷¹

Evaluations are most effective when they are created and planned for during the initial program planning. One significant benefit of this approach is that evaluation plans require an articulation of what, in fact, are the measures of change sought. This process will result in clearly articulated goals and objectives for the entire effort, as well as a commitment to timely feedback.⁷² For example, the Midlands Consortium, another of the Star Schools grantees, has proposed a research agenda for the 1989-90 school year.⁷³ This agenda is directed at investigating whether instructional television is especially useful or especially inaccessible to high-

risk students.⁷⁴ Midlands hopes to target research questions to evaluate how each different group of learners perform and react. Because of the Federal requirement to serve at-risk students through the Star Schools Program, this research may be valuable in determining instructional television's efficacy with these students.⁷⁵

A Final Note on Measuring Effectiveness

Some of the most important outcomes of distance learning may not be reflected in student test scores. Effectiveness is enhanced by offering students a chance to interact with peers from a range of socioeconomic and educational backgrounds at other schools,⁷⁶ providing diverse educational experiences for students, increasing parental involvement with courses, and exposing students and teachers to new technologies. The school environment and the community it serves can also benefit from distance education because of increasing cooperation between schools and districts and bringing in classes for adults, among others.⁷⁷ Overall program effectiveness is thus a difficult measurement to make. To the extent that distance education can create benefits such as those above, it may be claimed to be effective even without addressing the issue of how it impacts learning directly. Evaluation of ongoing projects can further delineate benefits, costs, and impacts of telecommunications technologies in the schools. Also, research over an extended period of time will help answer questions about whether the novelty of the technology itself may be producing positive outcomes. If this is so, once such efforts become routine, effectiveness may fall off and more accurate measures of the value of the system may emerge.

Distance education represents more than just a substitute for the classroom. The ability to manipulate the tools of communication are a critical requirement for a worker in the information age.

⁷⁰ *ibid.*, pp. 6-11.

⁷¹ Clark, *op. cit.*, footnote 62, pp. 7-11; and Barker, *Op. cit.*, footnote 6.

⁷² Clark, *op. cit.*, footnote 62, pp. 10-12.

⁷³ Although two of the Midlands partners have been broadcasting via satellite for a few years now, the Midlands Consortium itself is beginning its first year. Midlands Consortium Research and Evaluation Committee, "Midlands Consortium Research Agenda for 1989-90 School Year," unpublished document, June-July 1989.

⁷⁴ *ibid.*, p. 3.

⁷⁵ Many observers believe that self-motivated students are best able to take advantage of distance learning opportunities. Extensive USC Of distance learning for adult learning, training, and gifted and talented classes has reinforced this belief; however, no research has conclusively addressed this issue.

⁷⁶ Sometimes students who are at the top of their small rural schools find it a challenge to interact with other bright students in diverse distance classrooms.

⁷⁷ Batey and Cowell, *op. cit.*, footnote 48.

Much of business and industry today is conducted through computers, electronic mail, facsimile machines, and video conferences. Not merely a second choice, distance learning provides students a fore-

taste of the adult world they will be entering.⁷⁸ These benefits are largely unmeasurable by effectiveness research, but suggest the critical impact alternative experiences can have on today's student.

⁷⁸Jim St. Lawrence, SL Productions, personal communication, September 1989.