Chapter 1

Summary

Photo credit: Sal Skog, The Daily Inter Lake. Kalispell, MT

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INTRODUCTION

"Ohayoo gozaimasu, Moore-sari." So began the warm-up exercises in Japanese between Mississippi 12th grader Albert Moore and his telephone instructor, Chizuko Takechi in Omaha. For 1 hour a day, 2 days a week Albert practiced his spoken Japanese with Mrs. Takechi over the telephone. On alternate days, Albert participated in the Japanese class taught live via satellite from the Nebraska Educational Television studios in Lincoln, Nebraska. Albert and his counterparts in Houlka, Iuke, North Forrest, and South Panola High Schools were part of a small group of Mississippi students able to take the course. According to Albert, distance learning presented both challenges and opportunities:

> There is no teacher to hang over our shoulders, so we have to supply our own motivation and desire to succeed in the class . . . [at the same time, this experience] provided me not only with classes I would otherwise not be able to take, but an opportunist y to work with some of the most advanced technology of today, which is a learning experience within itself. [1]

On the last day of the school year, the 9,000 teachers and administrators from every school in the Dallas Independent School District came together to discuss AIDS, a growing crisis in their community. Not even the convention center could hold the group, and there were clearly not enough experts in the community available to travel to each of the 235 schools in the district to discuss the topic in the single day allotted for inservice training. The district's solution was to use the cable system recently installed in all school buildings to link all the teachers and experts at the same time. During this day-long meeting, time was set aside for each expert to discuss AIDS and its implications, for educators to react after each presentation, and for questions from the sites and answers from the experts.[2]

Next February, as the school day winds to a close, a small group of high school teachers will sit together in a classroom in their school located in remote northern Maine. They will begin a graduate class in teacher education taught from the University of Maine campus located 150 miles to the south. Instead of having to drive 4 or 5 hours each way in snow and subzero temperatures, along secondary country roads, these teachers will take this class without having to leave their own school building. Using the Community College of Maine/Telecommunications System, they will see and hear their instructor and discuss educational concerns with her and fellow teachers on campus and at other school sites. The format for this class will be repeated in other offerings for high school students, college students, and adults in Maine who will have the equivalent of a community college system for education and professional training. Special seminars, workshops, and meetings will also be offered.[3]

In these examples of distance learning, technology transports information, not people. Distances between teachers and students are bridged with an array of familiar technology as well as the new machines of the information age.[4] What sets today's distance education efforts apart from previous attempts is ". . . the

[1] Albert Moore, testimony before the Senate Subcommittee on Education, Arts and Humanities of the Committee on Labor and Human Resources, field hearing, Jackson, MI, Apr. 27, 1989.

[2] Diana Radspinner, cable communications coordinator, Dallas Independent School District, personat communication, July 1989.

[3] In September 1989, the Community College of Maine/Telecommunications System became operational in 23 high schools, all university campuses, 11 off-campus centers, the vocational/technical institutes, the Maine Maritime Academy, and the Maine Public Broadcasting Network through a mix of leased fiber optic cable and construction of a microwave and instructional Television Fixed Service network. Courses can be transmitted from any campus to [he off-campus centers and high school sites in its region or to all locations throughout the State. See University of Maine at Augusta. *Community College of Maine Newsletter,* March, May, and September 1989.

[4] Jason Ohler, university of Alaska Southeast, "Distance Education and the Transformation of Schooling," OTA contractor report, May 1989.

possibility of an interactive capacity that provides learner and teacher with needed feedback, including the opportunity to dialogue, clarify, or assess."[5] Distance learning relationships can be maintained in many ways from the simple exchanging of printed material via post or facsimile to two-way interactive, cross-continental television or computer networks. New technological advances and reconfiguration and combinations of older technologies offer an expanding array of learning options. Distance learning has changed dramatically in response to new technologies and new needs. Technologies for learning at a distance are also enlarging our definitions of how students learn, where they learn, and who teaches them.

At the request of the Senate Committee on Labor and Human Resources, the Office of Technology Assessment (OTA) examined the use of technology for distance learning to improve the quality of education for students and training for teachers. OTA analyzed the technological, economic, institutional, and policy barriers to further development of distance learning. This study focused principally on applications in elementary and secondary (K-12) education. Distance learning is defined in this study as the linking of a teacher and students in several geographic locations via technology that allows for interaction.

OTA finds that while distance learning initially served isolated rural schools and some urban systems, current uses go beyond these needs. Systems carry advanced and specialized courses and training and seminars for teachers. They link learner communities with each other and bring a wide array of experts and information to the classroom. If distance education is to play an even greater role in improving the quality of education, it will require expanded technology; more linkages between schools, higher education, and the private sector; and more teachers who use technology well. Federal and State regulatory policies will need to be revised to ensure a more flexible and effective use of technology for education.

DISTANCE LEARNING TODAY

Distance learning in K-12 education has increased dramatically over the past 5 years. Five years ago, few States or districts had either projects or plans for distance education at the K-12 level. Fewer than 10 States were promoting distance learning in 1987; 1 year later two-thirds of the States reported involvement.[6] Today virtually all States have an interest or involvement in distance education. Within States, a growing number of efforts involve local districts, regional education service centers, nearby universities, and community colleges. At the same time, an increasing number of districts are using services offered by public and private educational telecommunications providers. These multistate projects have experienced dramatic growth in student enrollment.[7] The Federal Star Schools program, begun during the 1988-89 school year, established a new multistate network and greatly expanded three others. **Nevertheless, many students and teachers do not now have access to needed but distant resources.**

Although spotty in terms of national distribution, distance learning has been aggressively adopted in many areas due to two factors:

- **Specific educational needs can be met.** One need is the provision of instruction in mandated courses or advanced, specialized courses in schools where teachers are not available or are too costly to provide for a limited number of students. A second need is the provision of training and staff development for teachers in locations where experts and resources are difficult to obtain.

[5] Dean Bradshaw and Patricia Brown, The *Promise of Distance faming,* technical paper (San Francisco, CA: Far West Laboratory, 1989).

[6] National Governors' Association, *Results in Education: 1988* (Washington, DC: *1988), p. 29.*

[7] In 1986 *When* the Satellite Telecommunications Educational Programming Network began operation, it offered 5 high school courses to 13 school districts in Washington State. Only 2 years later, the network served more than 800 students in 58 school districts in *8* States.

Photo credit: Kenai Peninsula Borough School Dtstrtct, Soldotna, AK

Students at Homer High School on Alaska's Kenai Peninsula can study Japanese, thanks to a course delivered by the Satellite Telecommunications Educational Programming (STEP) "Network in Spokane, Washington.

- **Recent rapid development of technology has resulted in systems that are powerful, flexible, and increasingly affordable. The** base of available technology resources is increasing. Information technologies continue to develop with dramatic speed. Possibilities for audio and visual interaction are increasingly wide. Much has been learned about connecting various forms of technology into systems, so that the ability to link systems one to another is growing.

Meeting Educational Needs

State-mandated curriculum reform, especially increased requirements for high school graduation or college admission, is driving many efforts. For example, the Oklahoma State University's Arts and Sciences Teleconferencing Service (ASTS) began to offer *German by Satellite* in 1985 in response to requests from local districts seeking help in meeting new State foreign language requirements. This provider and others have responded to similar needs in other States (see box 1-A). At the same time, some districts have created local and regional distance education applications to share their existing pool of teachers and students more efficiently and meet new requirements.

Maintaining quality within the teacher work force requires up-to-date skills and information;

Box I-A-Satellite Telecommunications Educational Programming Network

"Live! Via satellite from Educational Service District 101 in Spokane Washington! It's Advanced Senior English!" So began the start of class last fall for Heather L-owes, a student at Warrenton High School in Astoria Oregon, and her fellow students.[1] In this case, however, Heather was the only student in the classroom—her "classmates" were students located in about 80 other high schools spread across an eight-State area. Although physically separate, these students shared one teacher, Penny Cooper, who greeted them each morning in her Texas drawl with an enthusiastic "Waaall, good morning!" They also shared the demanding curriculum, which meets the content requirements of many college humanities courses and prepared Heather and her peers to take the Advanced Placement examination in composition.

With such a large and diverse "classroom," Ms. Cooper had to find new techniques to involve individual students and make everyone feel apart of the class. For example, while leading a discussion on *The Illiad,* she paused to ask various students to phone heron the toll-free 800 number to ask questions; as the students responded, their schools' names were flashed in 1arge letters on the screen and their home State was superimposed on a map of the United States. Other students can call the part-time assistants (called TAGs— "telephone answerers and graders") who answer questions raised by students and classroom facilitators and help grade student papers. From Monday to Thursday the students participated in the 50-minute satellite class, with Fridays set aside for the students to take tests previously sent from Ms. Cooper, review content, or complete individual or group assignments. Because classes are sometimes missed due to illness or scheduling conflicts in the home school (e.g., sports activities and assemblies), Fridays are also used as makeup days, when students can catch up by viewing a tape of the missed session.

Similar scenarios occur each day in high school classes all across the Northwest in the schools subscribing to the Satellite Telecommunications Educational Programming (STEP) Network. Like many distance learning systems, STEP was created to meet a relatively localized but common problem. School superintendents in Washington's Educational Service District (ESD) 101 service area needed help in delivering high school credit courses in subjects where they were unable to provide certified teaching personnel. They went to their ESD, which traditionally acts as a liaison between local school districts and the State education department and assists local schools in meeting instructional and administrative needs.

In considering distance education as a way to meet the need for courses, a number of technologies were considered. Satellite was chosen because ESD administrators wanted the capability to broadcast to the entire State of Washington, and because, fortuitously, an uplink capacity was available through Eastern Washington University (EWU) in Cheney, 20 miles south of Spokane. An agreement was reached with EWU and in September 1986 four high school courses were broadcast from an EWU studio to 13 sites in Washington. By the end of the second year,

[1] This example is taken from John Fortmeyer, "Youths' Lofty Goals Met Via Satellite," *The Daily Astorian,* Astoria, OR, Sept. 22, 1988, p. 3.

changing demographics and curriculum reform give urgency to professional and teacher education efforts. Technology can be a tool to reach teachers with training, information, and resources that enhance their skills and expand their knowledge. The National Aeronautics and Space Administration (NASA) teleconferences via satellite, the Dallas district inservice training via cable, the Maine telecommunications sys- tern, and efforts under the Star Schools program are examples. Technology allows teachers to meet and talk with national experts, visit other classrooms, take courses, or collaborate with teaching colleagues 5 or 5,000 miles away.[8]

Distance learning networks that provide courses can also bring people and experiences to the classroom to expand traditional instructional practices (see box 1 -B) or provide entirely new alternatives. Networks that connect classrooms to the home, business, and locations in the community provide ways to reach parents, offer

[8] For example, expert teachers in Iowa welcome prospective teachers into their classrooms via satellite, while two teachers in Connecticut join classrooms via a fiber optic network to team teach and build on their students skills: one group with expertise m Spanish grammar and literature, the other group with native language fluency and culture.

STEP had a membership of over 40 districts, including several in neighboring States and a modem uplink and production facility, the result of a partnership formed **between** ESD 101 and RSL Communications. Today there are over 100 STEP subscribers in 12 States.

STEP operates as a public, nonprofit cooperative. Costs are distributed among users. The operational budget is financed from the subscribing districts through installation, annual subscription, and tuition fees. While the director's salary is paid by ESD 101, all other costs (teachers' salaries, production costs, TAGs, and other support costs) are financed through member fees. According to the director: "NO special funding-not one dime-has come from State or Federal sources to support STEP programming."[2] ESD 101 makes available to new subscribers an equipment package that includes a downlink satellite dish and associated television classroom and telephone equipment and maintenance. Districts can also make arrangements to obtain their own equipment. In either case, first year capital equipment items required typically range between $5,000 and $6,000.[3] New members pay a $4,750 initial membership fee, which is renewed at $3,000 per year. Interestingly, membership fees for districts who elect not to receive staff development are higher, $6,000 for the first year and $4,750 each additional year. Charges for high school credit courses are based on a per student, per course, per year fee. Courses include Japanese I and II, Spanish I and 11, Calculus, and Advanced Senior English.

Enrichment courses are also offered, and reach down into elementary and middle schools. These programs are broadcast on Fridays, when regular STEP classroom instruction is not being broadcast. Student enrichment programming is optional, assessed at $350 per program or $1,000 for a total package of 10 programs.

As the fee schedule indicates, staff development is an important part of STEP programming. Course credit is available through EWU and Whitworth College, or teachers may take the courses for "clock hours" credit for advancement. Effort.. are under way to make it possible for teachers to complete a master's degree program via distance learning.

In the future, STEP programming and services may become part of a national network of similar providers. A step in that direction will begin in fall 1989 when the 'H-IN Network markets the STEP calculus course to its subscribers. "We would hope that there is more coordination between vendors, higher education, and the public schools, so that we could each exploit our strengths and offer affordable and high-quality services on a nationwide basis."[4]

[2] Ted Roscher, ESD 101 STEP administrator, personal communication, in Bruce Barker, Texas Tech University, "Distance Learning Case Studies," OTA contractor report, June 1989. In 1988, STEP applied for a grant under the Federal Star Schools legislation, but was not selected for funding.

[3] STEP recommends a 2.8-meter steerable downlink dish that is equipped with both a Ku-and C-band feedhorn, so local schools will then have the flexibility to pick up additional satellite programs besides STEP. Barker, op. cit., footnote 2.

[4] Ted Roscher, ESD 101 STEP administrator, personal communication, Aug. 30.1989.

after-school help with homework, or form new communities of learners (e.g., students, parents, business leaders, and librarians). In the future, a number of 1arge urban districts plan to build their own network so that common needs and rich resources can be shared.[9]

Distance education makes feasible the 1 inking of all levels of education--elementary, junior, and senior high to higher and continuing education. This fact has great significance because of the widespread current interest in restructuring many aspects of education. Distance learning networks that link universities, schools, and informal learning institutions, such as museums and public libraries, lead not only to expanded services but to new relationships.

OTA finds that successful applications of distance learning have been shaped by the

[9] Public school administrators in Chicago, Dallas, New York City, Philadelphia, and San Francisco have formed the National Education Technology Trust (NETT), a consortium to establish a video/data communications network " that will provide a link between students, staff, parents, and community members from large cities across our nation "13cmwd Solomon, The School District of Philadelphia, personnel communication, July 5,1989.

Box I-B-The Telelearning Project

The Telelearning Project administered by the Delaware-Chenango Board **of Cooperative** Educational Services (BOCES), is one of the pioneer distance learning projects in New York State. Begun in 1985, this audiographics network links 10 of the 18 school districts throughout this rural area of dairy farms and gently rolling hills, located about 50 miles northeast of Binghamton. Many of the 4 schools in the region art small and have had difficulty providing a full curriculum; many of the students have had little exposure to the world outside of the small villages that make up their remote communities. Sharing instruction via audiographics became art attractive means to expand high school credit offerings and to enhance educational opportunities for students.

In each of the first 3 years of operation, approximately 40 students at about a dozen schools took advantage of the three to five courses offered on the system. Last year only two courses were offered and student participation dropped to 15 students from 10 participating schools. The reasons for the decline included problems in scheduling, changes in the New York Regents core curriculum requirements, four different project administrators in as many years, and decreased State aid for schools, which made it difficult for some schools to pay membership fees and program costs. One of the key problems was teachers:

> When we first started the project we hired outside teachers (from the nearby university) who did an excellent job and excited students. Because of teacher union concerns the second year, we released these people and hired teleteachers within the ranks of teachers already teaching in schools serviced by the BOCES. Several of the teachers did not adapt well to the technology. Consequently, the students were not as enthusiastic as they had been.[1]

The current Telelearning Project coordinator has made teacher training a high priority, and is optimistic for the future. “In the last couple of months we’ve trained 10 teleteachers. We now have a cadre of personnel who want to teach telecourses and know how to do so effectively. With quality teleteachers teaching courses, the program will sell itself among students, other teachers, and administrator.”2

Two schools have used audiographics to teach homebound students. At one school, an eighth grade student was given audiographics equipment to use at home while recuperating from back surgery. The computer, graphics tablet, and speaker phone made it possible for him to take his regular classes from his bed, to participate in class discussions, not fall behind in his work, and keep up with his friends during this difficult time.

The project has also made possible the increasingly popular “electronic field trip.” An electronic field trip is a telephone conference call from one of the schools in the project to an outside authority or classroom. Over 50 of these field trips are conducted by participating schools in the BOCES region each year. The BOCES administrator explains the appeal: “Rural students are so isolated and have so little, if any, cross-cultural contact. One of the(ir) major needs is to come in contact with other people in other areas. The electronic field trip is a very simple and inexpensive way to give students contact with experts in a variety of areas.”[3] The calls can be as close to home as

1Freeman Van Wickler, executive officer, Board of Cooperative Educational Services, personal communication, in Bruce Barker, Texas Tech University, “Distance Learning Case Studies,” OTA contractor report, June 19S9.

2Linda Gorton, telelearning project coordinator, personal communication, in Barker, op. cit., footnote 1.

3Van Wickler, op. cit., footnote 1.

needs and objectives of education. Today’s technology makes it possible to meet these needs in new ways.

Advances in Technology

Advanced technological capability at lowered costs increases the options for distance education. **Most distance learning systems are hybrids, combining several technologies, such as satellite, Instructional Television Fixed Services (ITFS), microwave, cable, fiber optic, and computer connections. New** developments in computer, telecommunications, and video technologies continue to expand the range of choices, and new strides in interconnecting systems are being made regularly.

The technology is flexible, Existing technology resources in a community are most often the starting point for system development. Even though cable systems now reach many commua sixth grade class interviewing the mayor of Binghamton, or as far away as students in classrooms in Australia, Alaska South Africa and England. Students on electronic field trips have contacted social activists, artists, authors, historians, steel mill workers, and even a famous rock musician.

What is the benefit provided by electronic field trips? Some teachers have their doubts, commenting". . . that they were not prepared to spend an hour of their class time in order to prove the electronic wizardty of telecommunications."[4] Yet, a case study in which eight students spent several weeks preparing for their l-hour interview with a rock musician, suggests that with proper preparation, the students can benefit in many ways when the outside world can be beamed in to them.[5] Listen to Bob, a student generally not particularly interested in school:

> On Monday it was hard to pay attention during class. AU I could think about was the interview. . . .But this day was different. At the end of the day we got out of class a little early and setup the equipment for the (conference) call. Some of the teachers and even parents came to listen to the interview.

Bob and seven other students were about to meet with Paul Kantner, a musician and rock-and-roll star who has played with the Jefferson Airplane, the Jefferson Starship, and most recently a band known as KBC.

Although originally about 25 students expressed interest in participating in the interview, only those who were serious enough to do a background research paper were selected. These eight students, a mixed group of aspiring musicians, college-bound high achievers, and regular kids with no idea what their future may hold, threw themselves into the project with enthusiasm uncommon for teenagers. One described the interview:

> We were all seated at this table; the school board members allowed us to use their meeting room. We had been preparing for this interview with Kantner for over 2 weeks. When we started the interview 1 had my five questions but we talked so long I had to think up six new ones. We talked over an hour and 15 minutes. I think Paul Kantner would have talked longer. He was great because he really talked to us. He asked us questions and then listened to our answers.

When asked about their preparation, the students noted proudly: "The research was really important because it helped us ask intelligent questions." The music teacher, the Telelearning Project coordinator, and the librarian all worked closely with the students in the weeks prior to the actual interview. And, when the intetview was over, the students' enthusiasm lived on. "Kantner spoke to us about things that were important to us." "We would like to talk with another musician who has not made it big and compare the interviews." "My friends asked me about my interview, even my parents asked.""It has made school really special for these few weeks. I still get excited when 1 think about it." They had only one regret: ". . . even our local paper hardly reported what happened. If this had been a local football game they would have given it two columns of reporting. We hardly got mentioned."

These students were justifiably proud of the work they had done to make the electronic field trip a success. Like the football players who get the press coverage, they too had worked hard to win their goal. In the process, they had learned planning skills, how to organize their thoughts both on paper and on their feet, found out about a career to which some aspire, and learned to work as a team. As the researcher noted: "While the actual interview was a little like a familiar telephone conference call, the result was nothing like a casual conversation with a friend."

[4] Patrick Galvin, *Telelearning and Audiographics: Four Case Studies* (Ithaca, NY: Cornell University, June 1987), p. 11.

[5] The following section and quotes are all taken from ibid.

nities and the telephone network is ubiquitous, few classrooms have the basic wiring required to take advantage of this telecommunications base. And while satellites can reach locations thousands of miles apart, less than 10 percent of all school districts have the equipment to receive programming.

The schools' desire for technology resources comes at an opportune time. Educational requirements for infrastructure coincide with a growing demand for telecommunications capability and services coming from all sectors of society. **Education needs that parallel the needs of business, government, and health care providers create an opportunity to share costs. Even more important, this paralleling of needs has stimulated an active marketplace for hardware and services that has brought industry and the private sector to the door of the education community.** The capability of the technology, and its special ability to

Photo credit: AT&T Photofile

Our telecommunications links have come a long way from the era of the horse and buggy.

link groups of users, is creating many commercial activities and broadening markets in which education is a key player.

EFFECTIVENESS

In most instances, distance learning appears to be as effective as on-site, face-to-face instruction in the classroom. Extensive research indicates that distance learning is equally effective in applications for adult learners in nontraditional programs and for training of professionals in business, industry, and the military.[10] Distance learning has proven to be a powerful delivery system for many subjects and through many media. Although the evidence is incomplete in K-12 education, studies point to the need for competent teachers, valid instructional models, and appropriate institutional support. The recent development of distance learning in K-12 settings means that much must be learned about instructional design, teaching techniques, and various kinds of interaction that affect learner outcomes. Current distance learning efforts offer a rich source of data to be mined.

Distance learning affects the educational process in a number of ways. Students report having to take greater responsibility for their learning and that their experience helps them make the transition to higher education. Students also report that they benefit from exposure to a greater range of ideas, peers, and teachers made possible by the expanded educational community. At the same time, however, students report that distance learning is harder. When the distance learning group is large, students complain about difficulties in raising questions and obtaining help during class time.

Whether distance learning works equally well for all students is yet to be determined. Most applications to date have been with academically advanced high school students and independent adult learners—those who already possess strong study skills, high motivation, and discipline. Whether the medium of distance learning works as well with young or academically weak students—and under what conditions—needs further study.

Adult distance education is cost-effective when compared to traditional methods of instructional delivery, saving on travel and employee time. Experiences in adult learning and business and military applications have implications for teacher training and staff development. Few studies have examined cost-effectiveness of K-12 projects. Where traditional instruction is simply not available, comparisons of cost-effectiveness of distance education and traditional delivery are moot.

Many States and localities have plans to implement systems in the near future. **The next 5 years thus present a critical window of opportunity, while investment decisions are being made, for evaluation of and experimentation on distance education in K-12 settings.** Research on technology-mediated learning and interactivity, instructional design and innovative approaches, and applications of cognitive theory represent good investments for the Federal Government in order to meet the long-term needs of the field. Evaluation would be most usefully concentrated on practical questions about educational quality, such as what are the learner outcomes of various teaching techniques and technology models.

THE ROLE OF TEACHERS

The critical role of teachers in effective learning means that all must have training, preparation, and institutional support to successfully teach with technology.[11] Distance learning has dual impacts on teachers: as a tool for teaching and as a means to upgrade their own skills and professional development. Few **teachers have had either teacher education or**

[10] See Michael Moore, Pennsylvania State University, "Effects of Distance Learning: A Summary of the Literature," OTA contractor report, May 1989.

[11] 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), ch. 5.

Photo credit: Apple *Classroom of* Tomorrow, *Cupertino, CA*

Students look up information in a database and share their work with others on the electronic network, developing skills in communication and cooperation as they conduct their research. These activities spark self-reliance and excitement for learning.

field experiences that enable them to be effective distant teachers or successfully use technology in their own classroom.

Although it is the technology that removes barriers and expands opportunities for learning, it is the teacher who teaches. In distance learning, teachers find that they are required to change their method of teaching and give more attention to advanced preparation, student interaction, visual materials, activities for independent study, and followup activities. Many distance education teachers report that the experience has improved their teaching skills. It has forced them to become more organized and has challenged them to become innovators.

Teachers who work with other colleagues via distance learning systems are finding opportunities for new relationships: sharing parts of a course, team teaching, and learning from master teachers. The technology itself could be a mechanism for boosting the professionalism of teachers, by fostering access to experts and making high-quality training and professional development available to teachers wherever they are located. It can also aid in the process of learning how to be a teacher (see box I-C).

Teacher concerns about being replaced by technology must be taken into consideration in planning distance learning efforts. Teachers are concerned about the quality of instruction and the need for interaction with students. Involving teachers and the teacher unions early in the process can help to allay these fears when teachers see the opportunities created by distance learning. **Teacher input not only shapes development, it assures long-term support.**

Box 1-C—Teacher-LINK: An Electronic Network for Prospective Teachers[1]

The Curry School of Education at the University of Virginia created Teacher-LINK, an electronic bulletin board system, to link student teachers in the field with their university professors. The system is supported by a $1 million equipment grant from IBM, $15,000 in conferencing software donated by Metasystems Design Group, and a grant from the Centel telephone company to defray part of the cost of installing phone lines in teachers' classrooms. The remaining costs have been absorbed by the school systems.

Students receive an account on the network when they enter the Curry School of Education, and their accounts are retained until a year after graduation,[2] They can communicate with professors, classmates, professors at other schools of education, and classroom teachers. At the university, students access the communication system through a number of public computers in the education building and in their dormitories. During the teaching internship, they exchange lesson plans with advisers, obtain support from peers during difficult periods, and share teaching and curriculum ideas with others. It is hoped that ". . . by graduation, they will use the network as fluently as the blackboard and become the first generation of teachers trained to use an extended academic community as an instructional resource."[3]

One faculty member noted these benefits:

> Because I have different students, in different schools, teaching at different times, it is not easy to set up art efficient observation schedule by using the telephone. The electronic mail system has made the task of scheduling very easy, I can coordinate all my observations and also schedule around tests and quizzes, school assemblies. and other non-instructional sessions,[4]

About 80 teachers and 40 student teachers in 2 local school systems are now linked on the system. By 1990, the Curry School expects to link all the student teachers in the seven participating school districts. Future plans call for a computer network between the University of Virginia and local schools across the State that can be accessed by a local telephone cal1.

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[1]Earl Dowdy, University of Illinois, Urbana, "Computer Networks in Elementary and Secondary Education" (NTIS order number PB 88-194 675/AS), OTA contractor report, October 1987. Also James Cooper, dean, Curry School of Education, University of Virginia, Charlottesville, personal communication, July 1989.

[2]Much of this discussion comes from Glen Bull et al., "The Electronic Academical Village," *Journal of Teacher Education*, in press.

[3]Ibid., p. 16.

[4]Ibid., p. 9.

STATE ROLES AND CHALLENGES

States are **key players in distance education.** States are important because they set policy that shapes what is taught, who can teach, and what students learn. States provide funding and they also regulate telecommunications. In some cases, they develop statewide networks. Planning for the Iowa telecommunications network illustrates the importance of State leadership and support (see box 1 -D).

State responsibility for teacher certification, curriculum, and evaluation brings States directly into the development of distance education—particularly efforts that cross local district boundaries. Once efforts cross State boundaries. differences in State requirements and guidelines can present barriers to development-or opportunities for flexible new arrangements. States and local districts that want to use out-of-State resources have had to bend the rules or adopt interim policies, and have in some cases been thwarted.

Increasing the utility **of** distance education, accessing a wider range of instructional resources, and developing creative solutions to meet educational **needs will require a reexamination of State policies, rules, and regulations that were written in the context of traditional educational settings.** States may need to revise their definitions of classroom location and course credit, instructional roles, and funding formulas. Equally important, States may want to develop new standards and criteria for certification of teachers and evaluation of

Box 1-D--An Information Highway for Iowa[1]

> More and more States are recognizing that telecommunications systems are the highways of the21 st century. A good telecommunications system can make rural Iowa a logical choice for a business location or expansion. It can also help our schools prepare students to compete in a world economy.[2]

Iowa had a head start in educational telecommunications because of the pioneer efforts undertaken in the 1970s by Kirkwood Community College to reach beyond their local campus and provide courses to students in outlying communities. In the process of expanding its services to a broader audience of students, Kirkwood established relationships with other colleges, secondary schools, business, industry, labor, and the telecommunications industry, These partnerships were a key to Kirkwood's success.

Over the last decade, other community colleges, universities, and secondary schools in the State followed Kirkwood's lead and built or planned educational telecommunications systems of their own. By 1986, the Iowa General Assembly decided that statewide direction was needed. A goal was established to extend what was offered in better served portions of the State to those not reached by the community college or university system, and to extend educational links to elementary and secondary schools. Planning began in December of 1986; 8 months later a formal report outlining the Iowa Educational Telecommunications Plan was presented to the legislature.

The first step was to meet with educators at all levels across the State. At these meetings top officials of the State universities, the community colleges, the area education agencies, school districts, and businesses discussed their separate and common concerns and identified regional resources that could contribute to the system. In order to provide a common definition, a manual was prepared to give the organizations involved a better understanding of the technology systems available. These meetings caused potential users to look beyond their immediate needs and helped solidify support for a statewide telecommunications system.

Organization was the next concern. Because of their extensive community contacts, the 15 area community college districts were chosen as hubs for the system. The community colleges created a planning framework integrating educational telecommunications in their mission statements and confirming their willingness to become coordinators for their geographic area, Each of the other educational organizations in their regions were consulted to assure that they were comfortable with the community colleges' coordinating role.

One institution at the State level was needed to coordinate the entire system. Because it already had statutory responsibility for telecommunications, Iowa Public Television (IPTV) was considered the most viable organization to provide that coordination. A Narrowcast Advisory Committee that includes IPTV, representatives of the 15 area groups, and all other users was formed. The committee serves as a place where differences among users are aired, problems are resolved, and operational procedures and fees for the use of the system are set.

I.meal involvement in the planning process was high, fostered by town meetings to explain what was being planned and ways it could serve the community. These grass roots discussions encouraged a spirit of cooperation critical to the success of the project.

After all portions of the State were surveyed, a Request for Proposal (RFP) was sent out forbids on a statewide system with the capability of communicating on a local, statewide, regional, national, and international basis. The system called for the use of multiple technologies including microwave, Instructional Television Fixed Service (ITFS), fiber optics, and satellite. The RFP resulted in an award for the fiber optic portion of the system for $60 million; $20 million for the backbone system and $40 million for telelinks to the other sites-links consisting of microwave, ITFS, and cable systems. However, a recent challenge to the RFP and contract award was successful and, as a result, the RFP is being revised and the contracting process will be recompleted,

In the meantime, the legislature has awarded $50 million to fund the plan, and negotiations are expected to move forward. The Governor has made the educational telecommunications plan a linchpin to Iowa's economic growth.

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1 Much of this discussion comes from Larry G. Patten, "Future Technologies," OTA contractor report, May 1989; and OTA si(c visit, March 1989.

2 Terry Branstad, Governor of Iowa, "Condition of the Stale," speech delivered to 73rd General Assembly, Jan. 10, 1989.

students to assure that the quality of educational services is maintained or improved through the use of these resources.

In many States, impetus for distance **education** is coming from the State legislature, the Governor, the higher education commission, or the State education agency. In practice, the locus of control over distance education varies from State to State, and responsibility for educational telecommunications may reside within the State education agency or outside it. **Educational leadership will be a critical factor for planning efforts that draw together public and private sector interests, use resources efficiently, and meet a broad base of educational needs.** Interagency cooperation, shared cost arrangements, and connections between secondary and higher education are benefits of statewide efforts.

Telecommunications regulations that are most critical at the State level were not developed for distance learning. For example, State regulators control the pricing of telephone services as well as the development of the local telephone infrastructure. If States are concerned about effective use of telecommunications resources in distance learning, regulations and policy will need to be revisited.

FEDERAL ROLES AND REGULATIONS

Though important, the Federal role in funding distance education has been modest and has come from several diverse programs, most of which were not targeted to distance learning in K-12 education. Growth of distance education can be expected to continue for some time without increased Federal involvement. **A commitment to a major development, however, such as a national telecommunications infrastructure for distance learning, will require a change in the Federal role.**

Federal funding for the Star Schools Program has accelerated the growth of distance education

Photo credit: South Carolina Educational Television

This school, a site for the Federal Star Schools grant to the Satellite Educational Resources Consortium (SERC), offers Russian to its students.

in the United States through direct purchasing power as well as the familiar leveraging power of Federal money. Star Schools funded the development of four multistate, public/private partnerships for distance education, establishing one new network and greatly expanding three others. The Star Schools legislation, and the national attention it gave to distance education, served as a catalyst for planning and development beyond the projects that were funded in the first round. This groundswell of interest, enhanced by 2 subsequent years of planning and experience should manifest itself in an even greater interest in the second round of Star Schools funding. A total of $100 million was originally authorized over a 5-year period; approximately $67 million remains after the first 2-year cycle of grants.

Several Federal programs provide funds for distance learning hardware. The Public Telecommunications Facilities Program at the National Telecommunications and Information Administration, established in 1962, has funded the purchase of equipment used in distance

Box 1-E—The Jason Project[1]

Last May, a quarter of a million students in grades 4 to 12 explored the floor of the Mediterranean Sea as participants in the Jason Project. Their guide was Dr. Robert Ballard, discoverer of the sunken Titanic and marine geologist at the Woods Hole Oceanographic Institute. Ballard conceived of this project as a way to expose students to the actual process of scientific discovery, igniting their interest in science as an exciting career. As the remote-controlled robot vessel, the JASON, skimmed along the floor of the Mediterranean, its cameras sent live video images via a fiber optic cable link to the mother ship. (See figure 1-1.) Ballard and the other scientists *on* the ship recorded and interpreted for the students the archeological artifacts and oceanographic wonders being seen for the first time. These live images were sent by international satellite to an Earth station in Atlanta for transmission to science museums in the United States and Canada. Each of the 12 science museums in the Jason network had a command center mock-up replicating the shipboard command center. The student undersea explorers had studied a specially developed curriculum in science, social science, and history prior to attending the museum event. Each class expedition lasted 1 hour and included taped background materials, as-it-happens viewing of the scientists and the marine environment they were exploring, and question-and-answer sessions with Dr. Ballard and the crew.

The Jason Project is a partnership among many sectors. Woods Hole Oceanographic Institution, a private nonprofit marine research facility, is the coordinating organization for the project, and also is responsible for the 7-year development of the ARGO/JASON vehicles (funded by the Office of Naval Research). Electronic Data Systems provided the communications technology, equipment management, and staging at each museum site, as well as substantial funding contributions. The Quest Group, Ltd., a group of private individuals highly supportive of deep-sea exploration, is underwriting part of the project costs. Turner Broadcasting coordinated the live and preproduced portions of programming at a reduced fee. The National Geographic Society, producers of a film on the project, coordinated the involvement of the 12 museum sites around the country. National Science Foundation funding went to the National Science Teachers Association, which wrote the science curriculum for the project, with help from the National Council for the Social Studies. The total project budget was about $7 million, approximately three-quarters of which was for equipment and curriculum development, start-up costs that would not require support in future years. All parties are committed to doing the Jason Project again next year, using Lake Champlain and Lake Ontario as the sites for exploration.

The Jason Project is inspired by the advanced technology for seafloor exploration found in the ARGO and JASON systems developed by the Woods Hole Oceanographic Institution. The ARGO system, used to locate the wreck of the Titanic in 1985, is a series of television cameras and sonars that transmit both wide angle and close-up shots of the ocean bottom while maneuvering in the ocean. The JASON is a remotely operated vehicle that can negotiate the seafloor, retrieve samples, and do the basic reconnaissance needed prior to manned exploration. Together, the ARGO/JASON technologies represent a significant improvement in the speed with which oceanographers can explore the deepest parts of the ocean. Also, advancements in fiberoptic technology allow four high-quality television images to be transmitted from ARGO/JASON to the surface ship via a 4,000-meter cable.

The curriculum developed for the Jason Project takes advantage of the many educational opportunities provided by such a unique and advanced scientific effort. The science of oceanography is addressed, as well as other topics surrounding such exploration that fall under the physical sciences, biology, history, and geography. In addition, the Jason curriculum includes lessons on the telecommunications technology used to bring the pictures to the students, and the robotics needed to build and operate the ARGO/JASON exploration vehicles. Short lessons in mythology and creative writing connect the myths of Jason and the Argonauts to the current effort.

The Jason Project is a provocative vision of the future of distance learning. To date, most distance learning projects have attempted to replicate as closely as possible the existing classroom model of face-to-face instruction. In this traditional view, transmitting the image and voice of the teacher from a remote location into the classroom is seen as a necessary evil, a second choice. This view assumes that it is always better to interact with students face-to-face, rather than through a limited medium like television. Body language, the dynamism of a great teacher, puzzled faces, boredom—all of these elements of classroom management are perceived as compromised in distance learning.

In projects like Jason, however, the traditional classroom setting is reversed: instead of the teacher coming to the students, the students are electronically transported to a new site where teaching can occur. And rather than the media being a compromise, it now makes possible experiences previously out of the reach of students, and, for that matter. out of the reach of most adults as well. Distance learning technologies “. . . can be used to approximate experiments or experiences that are too dangerous, expensive or otherwise impractical in real life, such as flight simulation, working with radioactive materials, or a trip to a foreign country."[2] Field trips, a standard academic outreach experience, are transformed in two different ways. First, in experiences like Jason, traditional field trips to the local museum can be greatly enriched by remote explorations of deserts, ocean bottoms, and tropical rainforests. Secondly, electronic field trips beamed directly into schools that have satellite receivers (a possibility being explored for subsequent Jason experiences) can substitute for traditional field trips. This can be especially important to isolated schools where a traditional field trip to locations with significant cultural and museum resources is an expensive and often improbable notion.

The Jason Project seeks to combine the power and reach of the media with the experience of live, see-it-as-it-happens scientific research. Such experiences, built into a valid pedagogical framework, have the potential to broaden and invigorate the educational experience for children.

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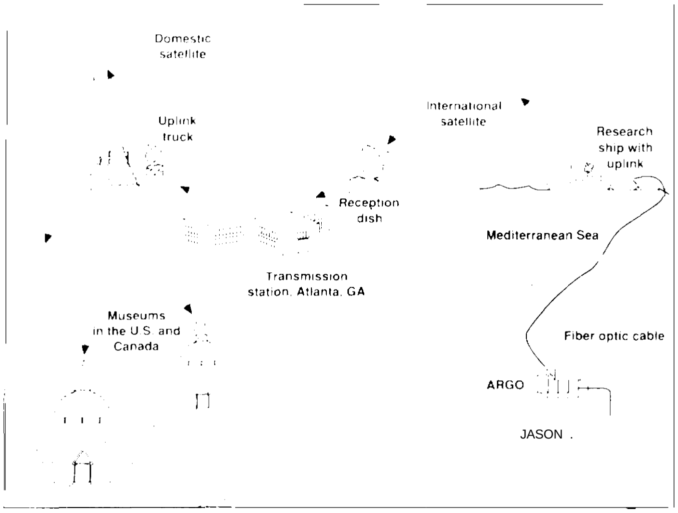
1 OTA site visit and interviews, May 1989.

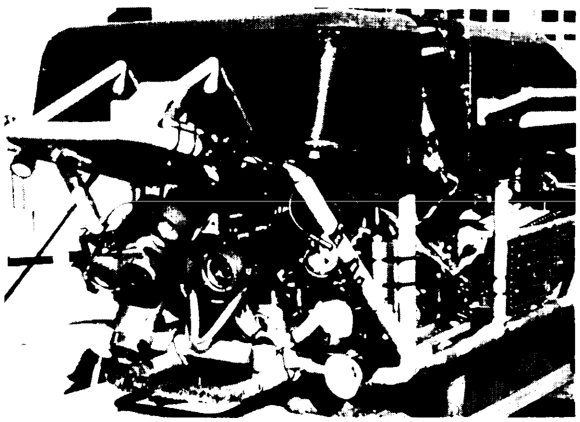
2 Jason Ohler, University of Alaska Southeast, "Distance Education and the Transformation of Schooling: Living and Learning in the Information Age," OTA contractor report, May 1989.

Figure 1-1 —**The Jason Transmission System**



As **JASON** travels on the seafloor, It sends video Images via fiber optic cable to the **ARGO control** vehicle on to the ship Star Hercules, research base for the expedition. An uplink sends the images and live commentary to **an** international satellite, which relays them to the broadcasting station in Atlanta, GA for addition of prerecorded sequences From Atlanta another uplink sends the programming to a domestic **satellite,** which sends signals to the 12 participating science museums in the United States and Canada, where students watch the whole process delayed only by seconds

SOURCE National Science Teachers Association, JASON Curriculum 1989



Phoro credit: Tom Kleindinst, Woods Ho/e Oceanographic Instltutlon

Meet **JASON, the remotely operated** robot vehicle that travels along the seafloor, sending pictures and data to scientists and students sharing in this live undersea exploration learning efforts.[12] The Rural Electrification Administration has provided loans for efforts with educational components to rural telephone cooperatives in Minnesota, the Oklahoma Panhandle, and the Papagos Indian reservation, among others. Title III of the Higher Education Act has supported part of the University of Maine's telecommunications network. Another area of Federal activity in distance learning is in training and information dissemination. Distance delivery of training for both civilian and military personnel has been used extensively for a number of years.

Some Federal agencies use distance education in executing their mission, while others fund curriculum development specifically targeted to remote learning environments, or provide technical assistance for planning and development. NASA's involvement with educational telecommunications began with launch of the first communication satellites that were used for education in 1974 and has continued with many activities, including the transmittal of images from vehicles in space, the teacher in space program, and an ongoing videoconference series for teachers. *3 The National Science Foundation (NSF) provided support for science curriculum development on the Jason Project (see box l-E) and numerous computer network projects. The Department of Education Star Schools projects spend 25 percent of their grants on courses for students and programs for teachers. Several Federal education laboratories provide information that is used by State and local planning groups.

Federal and State telecommunications policies, while promoting more industry competition and choices for schools than in the past, still limit the number and kind of telecommunications services available for distance education. The Federal Communications Commission (FCC) and Cable Act restrictions on the provision of video services by telephone companies, for example, mean that schools may have to bypass the local phone system, the most ubiquitous network in the country, if they want to deliver interactive video telecourses to students.

FCC also controls the availability of telecommunications channels through its licensing of ITFS channels, microwave links, and satellite launching and uplinks. As transponder capacity becomes scarce and channels are used up, pressures for FCC regulation will likely increase. Although the issue of set-asides for education is not new, policies in a deregulated system may need to be rethought.

Telecommunications pricing, unregulated for many transmission systems, is too high for some potential distance learning applications. This is an area that could involve Federal or State assistance, in the form of a special rate for educational telecommunications.

POLICY ISSUES

Distance learning is a growing force in K-12 education in the United States. More and more States are exploring the issue, and several have committed to building systems. A number of districts have also initiated efforts, working to link schools in their locality or reach out to neighboring districts. Many efforts involve schools, government, and the private sector. Distance learning's value to higher education and industry, and the rapid expansion of those

[12] In 1988, the program funded nine special nonbroadcast projects at a level of $2.25 million (12.5 percent of the Public Telecommunications Facilities Program budget). These grants include funding for the purchase of equipment for satellite uplinks, three new Instructional Television Fixed Services (ITFS) systems, expansion of two ITFS systems, and a microwave system; grantees include community colleges, universities, a county office of education, and community telecommunications networks.

[13] The National Aeronautics and Space Administration estimates that 20,000 teachers from all 50 States viewed the November 1988 conference on "Living in Space." William D. Nixon, Educational Affairs Division, National Aeronautics and Space Administration, "NASA Distance Learning---satellite Videoconferencing for Education," unpublished document, May 17, 1989.

efforts, reinforces the continued interest in this educational delivery system. **States, localities, the Federal Government, and the private sector all have roles to play in planning, funding, and implementing distance education. Future development will require involvement of these sectors in four major areas: telecommunications policy; research, evaluation and dissemination; the teacher's role; and the infrastructure for distance learning.**

Issue 1: Telecommunications Policy

Telecommunications policies can be barriers to implementation or they can expedite development. They require immediate attention at the national level.

Because communication technologies can serve as educational tools, they have always been valued as educational resources.[14] In policy debates over radio spectrum allocation in the 1920s, the value of radio for education was debated, but the Federal Radio Commission gave preference in spectrum allocation to commercial radio providers. The debate over television spectrum found a more organized and aggressive education community, aware of the special needs of education in a limited-resource marketplace.[15] The debate resulted in the Public Broadcasting Act of 1967, which reserved channels for educational television. Since then, the effect of telecommunications policy on education has not been explicitly debated at national levels even though the telecommunications industry has undergone a complete transformation with the advent of new technologies and changing governmental policies and regulations.

In a deregulated telecommunications marketplace, education may be at a disadvantage. However, education could prove to be a significant market, as shown by the variety and number of service providers who have already entered the field. For the promise of distance learning to be realized, the education community must make its requirements and needs known to the telecommunications policy makers, and policymakers must ensure that these needs are considered.

Telecommunications policies affect costs, capacity, and types of services available to distance education. Yet the Federal policy issues in this arena have not been reviewed in light of this fast-growing phenomenon. As Congress confronts telecommunications issues in the 1990s, and sets the direction for the 21st century, it will be critical to review and shape those policies to reflect the Nation's educational needs.

Issue 2: Research, Evaluation, and Dissemination

With the dramatic proliferation of distance learning projects in the last 5 years, many questions regarding effectiveness, methodology, and design have been raised. Many States and local districts plan to implement systems in the next few years. Research on distance learning would be a valuable investment for the Federal Government. Evaluation that explores learner outcomes based on various techniques and technologies is needed by States and schools, as they seek to match the right systems to their specific needs. The Federal Government can, through its traditional function as the funder of research, contribute greatly to the quality and effectiveness of distance education in this country. Also, because the use of distance learning in K-12 education is so new, many working systems still need fine-tuning. This means applying research and calling on the expertise and technical assistance of those with experience. The Federal education laboratories already serve dissemination and technical assistance

[14] U.S. Congress, Office of Technology Assessment, *Critical Connections: Communications for the Future,* OTA-CIT-407 (Washington, DC: U.S. Government Printing Office, in press).

[15] The organization behind the education community's efforts was the Fund for Adult Education, which secured the reservation of stations, the activation of these stations, and the establishment of the Educational and Radio Center. Robert J. Blakely, *To Serve the Public Interest* (Syracuse, NY: Syracuse University Press, 1979), ch. 4.

functions for the States and school districts, and could be well utilized. Many groups, including State agencies, institutions of higher education, and even private industry could serve as focal points for sharing information, perhaps with Federal leadership. Federal programs, such as Star Schools, and agencies, such as NSF or NASA, could convene meetings, working groups, and teleconferences on distance learning for school administrators and teachers.

There are significant educational resources owned by the Federal Government that might apply to distance learning curricula and instructional effectiveness. It is difficult to gauge how much of this material would be applicable to K-12 education, because so little evaluation or transfer is being done. The Department of Education Training Technology Transfer Office authorized in the Omnibus Trade Act of 1988 should generate momentum for this needed effort.

Issue 3: *The Teacher's Role*

Technologies for learning at a distance, while reaching a small but growing number of teachers today, will clearly affect the teaching force of tomorrow. Some will teach on these systems, others will use them to provide additional resources in their classrooms, and many will receive professional education and training over them. Few will be unaffected.

Given the current focus on improving the Nation's schools, enhancing the quality of the teaching force becomes more than a local concern. Congress is now considering how to help prepare new teachers and encourage more to enter the profession. Funding for teacher preparation institutions could support training in the use of distance learning technologies. Similarly, distance learning technologies can be powerful tools in the continuing professional development of teachers, and could be supported in an effort to upgrade the teacher work force. And, as the technology base in schools and colleges across the country is expanded, the concept of regional or national distance learning programs for teachers, similar to the system now in place for engineers, becomes more feasible. Federal and State support for planning and development could make this a reality.

Although States hold primary responsibility for setting standards for those who teach within their boundaries, distance learning raises issues of concern to the Nation as a whole. As barriers of place are removed, it is possible to think of teachers as national resources. A democratic country demands that every child has access to excellent teachers. Just as television made *Sesame Street* and *Mr. Rogers' Neighborhood* part of everybody's community, today's technologies make it possible for students to learn from teachers across the United States. While not advocating a national curriculum, the Federal Government has supported the development of curricular resources; similarly, there may be ways of making teaching resources available nationally.

If we look at teachers as one of our greatest national resources, barriers of State regulation and control may need to be reconsidered. The National Board for Professional Certification has already taken one step in suggesting that there be national standards for teachers, beyond the minimum licensure requirements of individual States. The Federal Government could play a role in convening States, on a national or regional basis, to assess their common needs and resources. These meetings could take place over distance learning systems. Federal support could also fund demonstrations of alternative entry and certification, compensation, and evaluation approaches for teaching that cross State lines.

Issue 4: *The Infrastructure for Distance Learning*

Distance learning is a viable, effective educational delivery mechanism to address important student, teacher, and systemwide needs in this time of educational reform. The number of local, State, and multistate efforts already in place or planned suggest that this resource is attractive and accessible. Transmission technologies have proven to be readily connectable; systems that are linked by cable can be connected to others that are linked by fiber, microwave, or satellite. Projects using one technology may face only modest costs to connect to a different technology. The growing infrastructure for distance education is composed of many systems, with varied administrative and technical characteristics.

National leadership could expand distance learning to those communities without resources and extend the reach of installed systems. Two approaches can be taken. The first is to build upon existing programs and structures, allowing the system to grow in response to local and State needs and experiences. This approach would consist of specifying expenditures for distance education in current Federal programs and providing continued support for hardware and software needed to interconnect systems. The Star Schools Program, the Public Telecommunications Facilities Program, the Rural Electrification's telephone loan program, and Chapter 2 funds from the Department of Education all contribute to the distance education infrastructure. The last three programs would have greater impact on distance education if program priorities targeted funds for distance education.

The second approach would be to commit to a set of national goals for distance education and to help with State and regional planning and development. Once goals are set, funds could be made directly available, through a grant program, to actively encourage States and localities to enter the system and expand the infrastructure. This approach would not replace existing systems; it would weave them together more quickly and thoroughly than would occur without national leadership.

Together with planning and funding for development, Federal commitments to teacher preparation and training, research, and dissemination will also affect the speed of implementation and the quality of the national distance learning effort. National leadership could bring in all the players and encourage effective collaboration between the public and private sectors. Most importantly, national leadership could focus investments toward the future, ensuring that today's distance learning efforts carry our educational system into the 21st century.