Linda K. De Grand

Development of a Distance Learning Infrastructure

Distance learning is rapidly becoming a fixed component in our national educational environment. This article describes the evolution of North Carolina's statewide distance learning infrastructure as an example of various technical and educational issues that emerge in such a process, including technological interconnection, educational outreach, and multi-institutional cooperation. Needs to be addressed for future growth include lower costs, enhanced instructional effectiveness, legal and regulatory concerns, and the question of national leadership for distance learning.

Since the mid-1980s a new industry and a new professional activity have been emerging—distance learning. The signs are everywhere: the U.S. Distance Learning Association has come into existence; a new journal, *The American Journal of Distance Education*, is published regularly; a number of annual conferences, sponsored by a variety of agencies, devoted strictly to distance learning issues, are conducted; the federal government has acknowledged the existence of the phenomenon with a study by the Office of Technology Assessment (OTA) and has passed legislation establishing a national "Star School" project, which is described by Frank Withrow elsewhere in this issue.

The speed with which this new area of study and service has emerged is, on the surface, overwhelming. The oft-quoted OTA report *Linking for Learning* noted that in 1987 fewer than ten states were interested in K–12 applications of distance learning. By the time the report was finalized in 1989, the OTA found that almost all states were exploring or implementing distance learning projects.

What happened in two years? A magic wand? Not likely. Rather, what appears to have triggered this rapid development is the interconnection of a number of localized projects, often termed "experimental" or "pilot." This interconnection is technological, geographic, and functional. The implications of this infrastructure for the future of all levels of education are significant.

Definition

Distance learning is still new enough that any discussion seems to require a definition. Indeed, in a new book, *Distance Education*, by John R. Verduin, Jr., and Thomas A. Clark some time is spent distinguishing between "distance education" and "distance learning." The primary distinction they make is that "distance learning" is much more self-directed learning, lacking direct interaction between teacher and student. Verduin and Clark further posit that distance education has the benefit of an organizational structure, whereas, to their mind, distance learning does not.

Such a distinction seems to put too fine a point on it, and certainly one today that is not often made. In common usage the terms are generally used interchangeably. For the purposes of this discussion, "distance learning" will be used within the following parameters:

- students and teacher are separated from one another geographically;
- there is a formal course of study or training, which generally has some form of evaluation associated with it; and
- the delivery system provides for real-time, "live" communication between students and teacher.

Some confusion *has* crept into the usage of the term "distance learning" because the delivery systems used for structured distance learning are, also, often used for videoconferencing (i.e., those instances when individuals who can't gather for face-to-face meetings use electronic media for discussion and the exchange of information). Rather than a disadvantage, however, these dual uses often provide significant cost/benefit justifications for the implementation of the hardware needed for either activity.

Emergence of an Infrastructure

Having dealt with terminology, let's turn to a consideration of this seemingly magical emergence of the institution called "distance learning." The state of North Carolina provides an excellent example of the evolution of a statewide distance learning infrastructure.

Agency for Public Television: Breaking the Sound Barrier

Since the late 1970s, a variety of interactive delivery systems have been put in place in North Carolina. The earliest effort was the state-mandated Agency for Public Telecommunications (APT). Created in 1979 to serve as the video production and telecommunications facility for all state agencies, it has evolved into a sophisticated communications center with satellite origination facilities in two frequency ranges, the C and Ku bands. Its award-winning Open Public Events Network (OPEN/net), while not strictly a distance learning endeavor, led to the creation of a cooperative relationship between APT's uplink facilities and commercial

cable operators throughout the state to bring an interactive public affairs program into the homes of more than two million North Carolinians.

Probably more important than the hardware interconnection was the public education process that took place. After decades of passively watching public officials pronouncing policies and commenting upon the events of the day over television, North Carolina citizens were now given the opportunity to pick up their telephone in order to ask questions and express their own opinions directly to their elected representatives and other public officials on a regular basis. Since its inception, OPEN/net has fielded over eleven thousand phone calls, or an average of 16.5 calls per one-hour program.

The State Services Network (SSN) is also run by APT and more closely falls into the category of a distance learning network. It is an institutional network, one that is quasi-closed circuit, received primarily by hospitals, colleges, and public schools. It contrasts with OPEN/net, which, as a residential network, reaches directly into people's homes. As with OPEN/net, the outreach of the State Services Network is based upon cooperative relationships. It has grown as the number of satellite receive sites has increased at various institutions statewide. In addition to videoconferencing, the network is used to provide more formal staff development for employees throughout the state.

One such example of this use is by the North Carolina Department of Human Resources. A spokesperson for that office described its use of the SSN: "My office has an extensive, ongoing training program involving four trainers serving child mental health professionals in our forty-one community mental health programs and six state institutions, resulting in approximately five hundred direct training hours per year.... SSN offers the opportunity to improve training and decrease travel time and travel costs."

MCNC's CONCERT Network: Institutional Blending

While APT was educating the citizenry about the power and possibilities of interaction, the Microelectronics Center of North Carolina (now called MCNC) was beginning to address the common educational needs of geographically separated institutions—and in the process bringing a convergence of industry, education, and medicine.

MCNC is itself an institutional blending—a partnership of public and private funding; of industry, research organizations, and universities, including their medical facilities. Its stated mission is "to build North Carolina's technical infrastructure for science-based economic development." Its services and resources include centers for microelectronics research, supercomputing, and communication.

The communications center operates both a data and a video network, the latter used for a variety of distance learning activities. Beginning with a prototype linkage between the University of North Carolina–Chapel Hill and Duke University in 1983, the two-way video network now covers four hundred miles, connecting Duke University; the Duke Medical Center; North Carolina A&T University in Greensboro; North Carolina

State University in Raleigh; the University of North Carolina campuses in Chapel Hill, Charlotte, and Asheville; Research Triangle Institute; UNC Medical Center, Chapel Hill; Winston-Salem State University; Bowman Gray School of Medicine of Wake Forest University; East Carolina University School of Medicine in Greenville; and MCNC itself.

Originally the network transmitted only via microwave. It now includes fiber optic and satellite interconnects. Called CONCERT (Communications for North Carolina Education, Research, and Technology), the network was an early user of two-way video. It focuses upon distance learning with approximately 60 percent of its capacity devoted to graduate courses in microelectronics, computer science, engineering, and medicine, as well as regularly scheduled seminars in supercomputing and high-performance computation, science, technology, and medicine. There is growing interest in sharing courses in teacher education among the participating universities. The remainder of CONCERT's time is devoted to videoconferencing. In 1989–90, over ten thousand people participated in network programming.

The institutions participating in the CONCERT network also have the capacity of reaching out into their local areas with instruction and even into the nation at large. For instance, North Carolina State University (NCSU) provides credit-bearing, graduate-level engineering courses to industries in the Raleigh area via low-power, line-of-sight microwave (ITFS), and participates in the National Technological University (NTU), using satellite technology. (NTU is a consortium of universities providing graduate engineering degree programs and seminars via satellite. As a part of its NTU relationship, NCSU is beginning testing of digital equipment that will greatly lower the costs of satellite transmission by increasing the number of channels of programming that can be transmitted over one satellite transponder. Use for course delivery is anticipated in 1992.)

Expansion of the Education Sector's Use

By 1987, the North Carolina Department of Public Instruction (NCDPI) and the North Carolina Department of Community Colleges (NCDCC) were also rapidly moving from the planning stage to full implementation of satellite receive networks to serve their constituencies.

Planning and Implementation Models

Both the NCDPI and the NCDCC efforts provide models that any institution might successfully follow in assessing needs, piloting a proposed project, gaining legislative support for funding, and finally building a program and gaining public support.

The NCDCC gained its initial experience with nontraditional delivery systems by providing broadcast telecourses to off-campus students. While lacking immediate, real-time interaction, this effort gave the state department and its constituent institutions experience with the coordination efforts involved in distance learning and with the necessary

logistical and administrative support structure required by this brand of off-campus student.

In 1987 a DCC task force issued a report, "Telecommunications: A Means of Improving Accessibility, Quality, and Economy of Services in the North Carolina Community College System." Its primary recommendation was "that the State Board of Community Colleges cause the development of policies and plans detailing the specifics of a statewide, dedicated community college telecommunications system to address the educational needs of North Carolina citizens." The report further identified five factors that needed to be taken into consideration as these policies and plans were created:

1. That funding of communications-technology-based education represents a central position in the state and institutional budgeting system.
2. That local private telecommunications groups be encouraged to participate in institutional and state efforts.
3. That appropriate incentives be provided to encourage institutional and faculty involvement in telecommunications learning strategies.
4. That institutional autonomy remain a primary consideration in selecting and purchasing equipment to satisfy local conditions and needs.
5. That a community college planning group be authorized as a permanent advisory entity to assist in planning and implementing telecommunications activity.

Subsequently, as a part of the overall effort, state funding was obtained and all fifty-eight community colleges now have earth stations in place. Using a portable uplink, or the APT uplink, the various community colleges in the system deliver professional development or informational programs to the other locations on an ad hoc basis.

With the Department of Public Instruction (DPI), the driving forces towards a distance learning effort were a concern for educational equity and the need for ongoing staff development opportunities for teachers, administrators, and support staff. As part of the planning process, a pilot teacher in-service activity had been conducted in 1986 by the North Carolina Department of Public Instruction. Six one-hour interactive satellite teleconferences were produced for teachers at three different locations. Topics covered integration of computers into instruction in various content areas. In the follow-up evaluation over 90 percent of the participating teachers indicated that they felt interactive satellite delivery was an effective way of receiving staff development. The DPI also armed itself with the results of an in-house survey, which indicated significant gaps in the abilities of small rural high schools to provide courses required by the state-mandated Basic Education Program.

Based on these data, legislation was prepared for submission to the North Carolina General Assembly. In August 1987, a $3 million funding appropriation was passed, to be expended over two years. In the first year a maximum of 154 satellite receive sites were to be installed. Fifty-four high schools having 450 students or fewer in grades 9–12 were to be equipped. The remaining satellite dishes were to be situated in a readily accessible location in each North Carolina county for the purposes of staff development.

Since its first year of transmission, the DPI Distance Learning by Satellite Network has served annually about one thousand students and over four thousand teachers and administrators *reporting* participation in network programming. Because registration is not required for all programming, actual usage is undoubtedly higher. In terms of cost effectiveness, one short course for teachers averaged $9.14 per participant in direct costs. Another three-hour training conference, part of a renewal credit certification package, cost approximately $6,000 versus the more than $40,000 that had been spent in previous years by conducting this training in eight different regional locations.

The Merger of Educational Interests and Technologies

In the spring of 1991 the governor of North Carolina and the president of Southern Bell's North Carolina operations announced a pilot project establishing two regional interactive video education networks. Each network will serve a cluster of institutions, including one state university, at least one community college, and several public high schools. In one network, in the Wilmington area, a hospital will also participate in the system. Both networks will be connected by fiber-optic transmission facilities. A total of sixteen sites, including the Universities of North Carolina at Wilmington and at Charlotte, will be connected in the two projects. The effort is part of a series of pilot initiatives being undertaken by Bell South elsewhere in the Southeast.

Similar projects with other telecommunications entities are being planned by educational institutions in the northwest and southwest parts of North Carolina. The Appalachian State University project in the northwest is especially exciting in that it will be implementing an Integrated Services Digital Network (ISDN). ISDNs use standard, cheaper telephone wire and service for carriage of voice, video, and data. The prospects for replication elsewhere in instructional settings are indeed tantalizing.

The significance of these efforts is not just the technologies employed or the fact that they represent individual programming efforts. Rather, the significance is that we are now seeing a blending of various educational levels, cooperating in the establishment not only of the hardware but also in the provision of courses supporting one another's needs. The University of North Carolina at Wilmington is giving serious consideration to delivery of courses to the two high schools participating in its network. In the three-county fiber-optic project in the Charlotte area, UNC-Charlotte School of Education is devising an expanded cooperative student teacher effort that maximizes opportunities for student teacher observation and incorporation of technology into student teacher training.

Implications

What are the implications of this case study? Are these just some additional isolated distance learning activities? Probably not. In the first place, the technologies to interconnect these projects are becoming readily

available. The programming being delivered via satellite can be plugged into the fiber-optic, microwave, and cable networks and vice versa.

Secondly, the geographical distribution of these networks is now becoming so pervasive that we are rapidly moving into the mode of "filling in the blanks" rather than just sketching the bare framework. Instead of facing a blank map with no roads whatsoever, we now not only have some expressways, but we are also building a vast network of secondary roads.

Moreover, these need not be just state roads. The potential for electronic interstate highways is real. A number of universities are using these "interstates" for the delivery of entire degree programs: George Washington University offers a master's degree in instructional technology; the University of Arizona is beginning delivery of a master of library science degree. California State University at Chico offers a computer science degree, and, of course, the National Technological University was founded for the sole purpose of providing a variety of graduate engineering degrees across state lines.

International educational resource sharing is also becoming a reality. The University of California at Los Angeles shares classes with Seoul National University via an audiographics system, which uses standard telephone lines to convey voice, text, graphics, and video images. The University of Lowell College of Education has organized a program for interaction between middle school students in Massachusetts and Germany via satellite.

Thirdly, as the North Carolina experience described above indicates, we are seeing a multilevel educational focus as these networks are used cooperatively by a variety of entities. For colleges and universities it means a new vehicle for communicating and working with the K–12 sector that sends them students, with the teachers they have trained, with the businesses that have employed their graduates, and with adults who require professional updating and access to lifelong learning. The networks' purposes are always education, whether it is called teacher in-service, high school instruction, graduate education, employee training, professional continuing education, public awareness, or public service. The list goes on.

Various cooperative funding mechanisms exhibit the merging of public and private interests coming together to support these electronic educational networks. MCNC was an early example. The recent call by the governor of Kentucky for a satellite devoted strictly to education, and the serious study of this notion by the Education Satellite Institute, a telecommunications research group, reflect this focus. The willingness of the private telecommunications sector to support distance learning efforts with their technological expertise and dollars further reflects the needs expressed in *America 2000, An Education Strategy*. This document includes the urging that the United States must become "a nation of students." Moreover, if the experience of North Carolina is any indicator, with a proper introduction, the public at large is willing to accept the concepts of distance learning and the use of these electronic highways.

Future Directions

Much remains, of course, to be done. A number of major issues still need to be addressed. Technologically, while we are "filling in the blanks," much of the success of that effort will depend upon costs. Suppliers of fiber-optic transmission, in many instances, continue to grapple with developing an ongoing line charge pricing structure that will fit the budgets of educational entities. As *Linking for Learning* reported, the range of prices for fiber leasing is still wide—including anywhere from $70 per mile per month to $28. When a local school system or school-university consortium is faced with the prospect of annual operating costs of $100,000 or more just for line charges to connect a handful of sites, the enthusiasm for distance learning often fades.

The same holds true for those dependent upon satellite delivery, particularly with the current crisis in available transponders. Even with split transponder technology the rate is at least $325–350 per hour if volume transponder time has been purchased. Consequently a class meeting five hours per week has an ongoing operational $60,000 price tag before any other costs are even taken into consideration; a three-hour class has a cost of $35,000 to $38,000. Only the potential volume of tuition-bearing students on a national basis can generally justify such annual expenditures. The anticipated use of digital technology to increase the channel capacity of available transponders will come; but, again, there will be a price as existing systems are retrofitted with the necessary receive equipment. The primary cost issue, however, is not the initial capital cost, but rather the ongoing operational cost.

A more positive consideration in the technology sector is the potential for incorporating telephone-based, computer-driven peripherals to enhance the instruction being carried by the base delivery system, be it microwave, fiber, cable, or satellite. Fax machines for the transmission of hard copy are already routine additions to many distance learning systems. The Kentucky Educational Network has developed a potentially invaluable immediate response keypad system for polling all remote-site students and gauging pacing and understanding of instruction. The TI-IN Network, a national provider of teacher in-service and high school instruction, is using a tiered voice mail system to enhance communication between teacher and student. As students call into a classroom they may reach the teacher directly or be routed electronically to a teaching assistant or a voice message "box." We are basically only at the threshold of integrating these technologies into our distance learning delivery systems.

We are entering a new instructional age comparable to the emergence of film from stage and vaudeville.

These technological considerations bring us to functional considerations. If education is our focus it is fair to say that we are just entering a new instructional age comparable to the emergence of film from stage and vaudeville. Early films were nothing more than a camera pointed at a stage. Today much of our interactive video-based distance learning is exactly that—a camera pointed at a teacher. Principles of

instructional design and teacher training must be revamped to move us from that mode.

As instructional design and teacher training are reconsidered, we will have to move our evaluation efforts forward. The cry still exists for evaluation efforts to "prove" that distance learning instruction is "as good as" traditional in-class lecture, where "as good as" is generally taken to mean "the same as" the traditional class. Under any circumstances, the issue should not be whether distance instruction is the "same as," but rather whether it is "as effective as" traditional instruction. Although the topic is not as frequently studied as one might anticipate, there is research that suggests a positive answer to that question. However, in addition to further study of "traditional" and distance learning instruction, we need to be moving on and focusing on which of various *nontraditional* instructional techniques is most effective for the delivery of distance learning. We need to quit trying to make the distance learning "classroom" look like the classroom of the nineteenth century—or even of the most recent decades.

As it was initially with the now-ubiquitous photocopier, legal and regulatory issues have yet to catch up to distance learning technology in the delivery of education. The whole issue of "fair use" of materials in the classroom takes on new meaning when that "classroom" consists of multiple locations in thirty or more states. Program accreditation and teacher certification also require new consideration. Currently the national Council of Chief State School Officers is considering a proposal providing reciprocity of state certification for distance learning teachers. This proposal would eliminate such anachronistic practices as requiring a teacher certified in one state to pass another state's physical examination or state history test. Postsecondary institutions and their program accrediting associations have not yet been as systematic in dealing with governance issues.

Finally, to address all of these issues and more on both a local and a national basis, still needed is the emergence of an educational leadership that blends all of the concerned entities and individual participants together. There are still a number of contending voices for this leadership—not to mention those institutions, particularly at the postsecondary level, that are still calling "foul" at what they perceive to be an invasion of "their" turf.

The United States Distance Learning Association recently conducted a national policy forum on some of these issues and invited representatives from postsecondary institutions, K–12 agencies, and program and technology providers. This is a good start. However, the national initiative must continue to be balanced by the local in order to win full public support. For instance, the North Carolina Inter-Agency Distance Learning Task Force, which brought about the two most recent regional pilot fiber-optic projects, is made up of representatives from individual public school systems, local universities and community colleges, the governor's office and other state agencies, and private carriers.

The efforts of such regional entities will support the efforts of national policy makers by making distance learning a reality and a valued service to the general public. In the process, educators must realize that

electronic highways are like those made of concrete: the value of the road is never fully realized until it passes by your door and takes you to town.

Suggested Readings

Bruder, Isabelle. "Distance Learning," *Electronic Learning* (April 1989): 31–35.

EDSAT Institute. *Analysis of a Proposal for an Education Satellite.* Washington, DC: EDSAT Institute, 1991.

Hansel, Daytra. "International Distance Education: University of California, Los Angeles and Seoul National University," *ED* (May 1991): 9–10.

LeBaron, John, and Rebecca Warshawsky. "Satellite Teleconferencing between Massachusetts and Germany," *Educational Leadership* (April 1991): 61–64.

Office of Technology Assessment. *Linking for Learning*. Washington, DC: Office of Technology Assessment, 1989.

United States Department of Education. *America 2000, an Education Strategy*. Washington, DC: U.S. Department of Education, 1991.

Verduin, John R., Jr., and Thomas A. Clark. *Distance Education*. San Francisco: Jossey-Bass, 1991.