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AUTHOR	Blaschke, Charles L.
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ABSTRACT

This paper provides commentary on some of the issues and projects considered in other papers presented at the conference, focusing in particular on some of the nontechnological issues associated with the design, development, and implementation of telecomputing and networking in education. Four types of telecomputing projects are considered: national telecomputing projects, statewide networks, local or community-based networks, and hybrid interactive distance learning projects. It is suggested that the major challenges in these four areas are political and economic, and that the high turnover rate of individuals involved in such projects is due to these political and economic issues, as well as to the volatile nature of telecomputing and networking ventures in education. The fact that half of the authors who presented papers at the conference in September 1986 are no longer officially involved in the projects they described is cited as an example of this instability. It is argued that if the potential of telecomputing, distance learning, and other projects is to be realized, these problems must be addressed at various policy levels. (EW)

Networking in Education

The Need for Managerial and Political Innovations

Charles L. Blaschke

Introduction

For a society so adept in developing technology, we have been remarkably inept in developing the political, social, and organizational innovations to create an environment conducive to the effective use of advancing technology. As computer and telecommunications technologies continue to converge, this is particularly the case with telecomputing and networking in education.

The purpose of this paper is to identify patterns and trends in telecomputing and networking, following the models described in this document, as well as other models; and to describe some of the nontechnological issues associated with design, development, and implementation of telecomputing and networking in education. The need for such an analysis became apparent as this paper was being prepared; five of the ten authors who presented papers in September 1986 are no longer officially involved in the projects they described ten months earlier. Most of the reasons for this high rate of turnover can be attributed to a combination of political and economic issues and the volatile nature of telecomputing and networking ventures in education.

Because many of the political problems were addressed only briefly in the authors' papers, the authors and officials in other projects were contacted for updates and follow-up information. Our experience in planning, evaluating, and participating in technology projects at the national, state, and local levels over the last two decades also provided a perspective for this commentary.

To identify relevant trends and issues, we have focused the following discussion on several somewhat overlapping telecomputing families:

- National telecomputing projects
- Statewide networks
- Local or community-based networks
- Hybrid interactive distance learning projects

National Telecomputing Networks

National telecomputing networks are a phenomenon of the 1980s. Their growth in education can be attributed to some of the same factors that have encouraged statewide networks. Because most of the large gateway telecommunications networks (The Source, CompuServe, and Telenet, for example) have designed and implemented systems primarily for the private sector, in most instances education has been treated as a "stepchild." As a result, some of the most successful national education telecomputing networks have had to be designed, at least initially, for specific education communities. In many respects, however, they are still dependent on the priorities of the gateway networks.

Three national networks are discussed in this section: (a) Chieffile, operated by the Council of Chief State School Officers (CCSSO) as part of NSPRA's ED-LINE, which relies on The Source; (b) SpecialNet, operated by National Systems Management, Inc. (NSMI), which uses Telenet; and (c) the McGraw-Hill Information Exchange (MIX), operated by McGraw-Hill. While each of these networks is similar in some respects, each has approached the education market somewhat differently in addressing political, economic, and related problems.

The economic issues surrounding national networks must be the primary concern—especially pricing. NSMI has used "subsidies" and user rates as components of its pricing policy. The subsidy has included marketing support from the National Association of State Directors of Special Education (NASDSE), which encouraged state and local agencies to purchase a combination of equipment, connect time, and other components of the network. Over time, differentiated pricing has evolved (for example, if a state is willing to handle administrative functions, then districts get a 50 percent reduction in their rates); a similar arrangement exists for large school districts, which can get rates as low as $35 per building. Chieffile relied heavily on a combination of CCSSO-subsidized network operations, including an NIE grant to establish an information-sharing system and SEA payments for connect time. The MIX network used actuarial rates to develop a pricing arrangement calling for a specific user charge per access, regardless of amount of time used. MIX is now partially subsidized by the state of Minnesota.

While the fixed price per access certainly assists schools in budget planning and forecasting, being able to peg a price becomes risky for the network operation. Government subsidies—either at the federal or state level—can absorb initial costs and increase the critical mass of subscribers, but the network operator is often faced with the vagaries of government funding. In fact, after NIE funding ceased for CCSSO, Chieffile's state files have not been updated, and its key operator subsequently left CCSSO.

Because federal funds were used at different stages to support network implementation, Chieffile and SpecialNet were subject to political allegations. During the 1970s, ARPANET, the largest network of its kind, was in jeopardy because it was alleged to have contributed to the movement to impeach President Nixon. Both CCSSO and NSMI have successfully shielded their networks from such potential problems during the 1980s.

One of the objectives of NSMI has been to provide users with peripherals, communications software, and other services (including training) to reduce on-line time and to minimize connect-time charges. In its attempt to provide additional services, such as software downloading, NSMI has not been able to obtain the necessary support from the national networks, because the education market is not a clearly established priority for many of them. MIX recently provided editorial and other support to bulletin board and data-base operators; this approach is different from that of SpecialNet, which relies on bulletin board operators to absorb the time and other costs of operation.

Each of the systems is based on structures within which the network operates. For example, SpecialNet and Chieffile relied on an organizational structure (NASDSE and CCSSO, respectively) to facilitate initial subsidies, marketing, and support activities, factors that key individuals from both groups feel have been critical to their success or failure. MIX, on the other hand, relies on the sales, marketing, and support structure of McGraw-Hill to meet the existing market demand. Marketing of Einstein involves some new creative strategies by Addison-Wesley. In general, Chieffile and SpecialNet use a structure to *create* a market, while MIX relies on its existing structure to meet an *existing* market demand.

Officials within each of the networks feel that their challenge is to identify target audiences and to ensure that these audiences get the information they require at a reasonable cost. This challenge is a continuing one, because both audiences and their information needs change over time. The one constant factor that appears to contribute to each of the networks' success has been the ability for peers in other states, districts, and locations to communicate—through two-way bulletin boards and electronic mail—regarding common areas of interest.

Over time, a number of management issues have arisen with respect to each of the networks. For example, NSMI has addressed the issue of information control by operating a number of closed bulletin boards in addition to their open ones, and has enforced guidelines on advertising on the network, particularly by private-sector subscribers. A major issue regarding control on Chieffile has been finding ways to minimize duplicative information gathering. An internal review committee, similar to that used in FIRN, was established to conduct periodic reviews of information requests.

Support management is also a big issue, particularly with regard to training and technical assistance. The implementation of Chieffile was based largely on the assumption that individual state superintendents, if adequately trained, would use the system. The actual systems operators (that is, other state staff) were not, therefore, the focus of initial training and support. NSMI has attempted to develop a support structure, relying heavily on state-level operators and projects, to provide training and follow-on support to districts using SpecialNet.

State-Level Administrative/Telecomputing Networks

By 1970, more than 60 percent of the school districts and virtually all state departments of education had one or more automated administrative reporting system(s). The initiation of these systems was prompted by (a) the availability of mainframe computers, relying on relatively low-cost telephone data transmission capabilities; (b) the need to meet federal reporting requirements related to legislation passed during the mid-1960s; and (c) state funding formulas that allocated funds based on information reported from districts. Where state funding for district-specific programs (such as special education and vocational education) was based on student counts, the number of certified teachers, and other variables, these types of LEA/SEA reporting systems were relatively responsive and accurate, due to the potential for state and federal audits.

During the 1970s, a number of states attempted to develop comprehensive, multipurpose LEA/SEA networks, some of which involved telecomputing. The largest and most sophisticated of these was Minnesota TIES, which had many of the functional capabilities of sophisticated systems today. With the advent of microcomputers, TIES and other statewide reporting systems were forced to consider the trade-offs involved in using large mainframe or dumb-terminal systems versus microcomputer-based systems. Political battles between advocates of the two systems often ensued. Indeed, in many areas in which comprehensive mainframe systems were not in place, establishing microcomputer-based administrative reporting systems was easier to accomplish, either in specific program areas (special education, vocational education) or on a statewide basis.

During the 1980s, the number and variety of statewide administrative/ telecomputing networks increased dramatically, for several reasons. First, the hardware base (including terminal equipment) increased rapidly at the district and school-building levels. Second, due to advances in telecommunications technology, alternative means of transmission, including fiber optics, videotext, and satellites, became available. Third, deregulation by the FCC opened new opportunities (such as the FM SCA, SAP, and other previously "protected" channels), and the divestiture of AT&T created additional communication alternatives. Fourth, and probably most important, during the mid-1980s, the major hardware vendors in the education market began to promote statewide administrative/telecomputing networks in response to state-level requests. These vendors gravitated toward a concept that was different from their original architectural designs

(for example, Apple's bottom-up, stand-alone approach versus the large mainframe vendors' top-down, centralized configuration). And last, during the early 1980s, as microcomputer and telecommunications technologies converged, governors and legislatures began to see states as playing a pivotal role. In the area of telecommunications, their role in centralized information gathering and dissemination could be easily justified based on economies of scale. Hence, in most states, state administrative/telecomputing networks have become a priority.

The statewide networks currently in place (as well as the many more in the process of being implemented) vary widely because of state priorities and other factors. During the mid-1980s, West Virginia established a statewide instructional network designed to facilitate communications among instructional staff at all levels and to distribute licensed or public domain software for instruction, especially in vocational education at the secondary level. The initial system relied heavily on Job Training Partnership Act (JTPA) funding; strong leadership from the legislature not only arranged for JTPA funding, but also assisted in the design of the system's architecture. Subsequently, this system has expanded to include other instructional areas and to provide administrative reporting, with the goal of cutting paperwork by more than 50 percent by 1990. Currently, Georgia is pilot-testing a comprehensive administrative reporting system in several sites; similar systems are being planned or implemented in Nebraska, New York, and North Carolina, among others. In other states, telecomputing networks that include minor administrative reporting (student, personnel, and financial data, for example) rely on a variety of telecommunication gateways or networks (Texas uses Electric Pages; Kansas, SpecialNet; and Minnesota, McGraw-Hill's MIX).

Two of the statewide network systems described in this book, FIRN (Florida) and EdLink (New Hampshire), represent two different types of networks. They can be considered models in terms of their functionality as well as their planned strategies for design and implementation.

FIRN

FIRN—the Fiorida Information Resource Network—is probably the most comprehensive statewide reporting system in education today. FIRN has succeeded by addressing a number of factors that have plagued network implementation in other states. First, although FIRN was officially created and funded by the legislature in 1982, initial planning—particularly at the Department of Education and local district levels—began over a decade earlier, through the creation of the predecessors of the School District Council for Comprehensive Management Information Systems. The increased authority, over operational problems in particular, of this group and the FIRN Coordinating Council, which was formed to establish policy and guide future development, became critical in the implementation of FIRN.

Second, as noted in the Watson paper, approximately half of FIRN's applications are designed to assist local districts, while the remainder are designed primarily to assist state officials in their monitoring and reporting functions. Because districts would be using FIRN data bases for their own purposes, this balance contributed significantly to incentives to enter accurate data into FIRN. Moreover, many of the initial types of data reported to FIRN were used by state officials in apportioning funding to the districts, another incentive to ensure quality and timely reporting of data from the LEAs.

Third, most historical studies of state departments of education and their relations with local districts rank Florida among the most centralized and politically active in the country. Implementation of FIRN within this context is remarkable. While Watson notes that some political problems arose (suspicions between different agency types linking autonomous agencies into a unified network, for example), the planning and oversight structure, along with the open involvement of the legislature in the planning and implementation of FIRN, provided opportunities for political issues to be resolved through open discussions.

And finally, mechanisms were established to ensure that implementation of FIRN would not be misdirected or otherwise jeopardized. In some states, the implementation of statewide reporting systems has been severely impaired because state education agency officials initiated "ad hoc information-collection activities," thus eroding the overall credibility of the automated system. To avoid this problem, a subgroup within the FIRN council was required to approve any Department of Education information request and, if any local district received a form that was not specifically approved by the council, the districts were not obligated to complete it.

EdLink

The context in which the New Hampshire EdLink network has been implemented differs from that in Florida. Traditionally, New Hampshire has been a "local autonomy" state, with less than 10 percent of education funding derived from state or federal sources. The state department has minimal leverage for instituting statewide administrative/telecomputing networks. These realities have required careful planning and sensitive implementation during the last year.

One of the factors contributing to EdLink's success has been the underlying philosophy that such success will be directly related to the perceived benefits to users, who will express their satisfaction by paying for the information (via hardware and connect-time costs). Moreover, because EdLink is a user-driven system, the identification of user information needs is based on an iterative process, as information requirements continually become known to the state-level systems operator.

Another factor contributing to New Hampshire's success was the lack of a statewide mainframe reporting system prior to the introduction of the microcomputer. This allowed planners to take advantage of the emerging microcomputer base without encountering resistance from mainframe advocates.

As Vaughn notes in his paper, New Hampshire's planners recognized the need for training superintendents and others during the pilot phase. According to Vaughn, because the AppleLink system was so easy to use, the training process was considerably less troublesome than with other systems.

Cognizant of the political sensitivities involved, the state's planners also ensured that the network, particularly the two-way bulletin board system, was completely open to all users. While certain "folders" were designed for specific user categories (superintendents, microcomputer coordinators), any user could have access to other folders for general information gathering and posting. This openness also provided opportunities for the creation within the network of "communities of users" that shared information with their peers, a capability that Vaughn argues has contributed most to the network's overall success.

And last, the New Hampshire EdLink network is a model of participation between the education community and the private sector—in this case, Apple Computer. Apple not only provided special rates for equipment, but also contributed approximately 4,000 hours of free connect time per month during the pilot demonstration. Apple support continues today, with the possibility of developing some data bases on AppleLink that are specifically related to New Hampshire.

The EdLink model has been tested in Mississippi, and expansion is planned for ten to twelve additional states in the immediate future.

School/Community-Based Networks

Four authors describe projects that fall into this category. Even though the Maryland Education Technology Network (METN) is often perceived as a statewide telecomputing system relying on broadcast distribution of software, the heart of the project today is 30 local area network configurations in as many schools. The MacJANET system used at the University of Waterloo and elsewhere represents a local area network used primarily as a tool for the teacher to distribute software. The CMS School-Net system, described by Rogers, differs in many respects from the other two systems in that its major purpose is to provide teachers and students with opportunities and motivatic to "write ' to each other over the network. Learning Link is a multipurpose, community-based network that, in addition to providing telecommunications, offers subscribing schools access to a software review data base and procedures to be used to select and order software. Both MIX and Addison-Wesley's Einstein can be accessed through Learning Link, which has been adopted for use by the Software Communications Se vice, a consortium of SEAs and public television stations in more thai '5 states.

Before I discuss some of the problems and issues associated with these and other networks, however, several comments about current local area network (LAN) trends are appropriate. Interest in school networks has increased dramatically in the last two years. In 1985, for example, TALMIS reported that 14 percent of its school respondents used microcomputers in one or more network configurations—2 percent at the elementary level, and more than 33 percent at the senior high level. A district-level survey of the largest districts (enrollment of 25,000 or more), conducted by Quality Education Data (QED) in 1987, reported that 53 percent currently used local area networks, with an additional 30 percent planning to use networks by 1990. Arguments in favor of networks include savings on software costs and reduced use of aides to provide group instruction. Negative comments usually relate to the expense of the system, its complexity, and the lack of generic instructional management systems.

An increasing number of vendors are also promoting "hardware independent" network systems, a concept that is very appealing to cost-conscious school official · Such systems allow schools to use existing microcomputers to "experiment" with networking. Over the last year, the number of software publishers who license their software for use on networks has doubled, with the greatest increase occurring among small to medium-sized K–12 education publishers. Lest illegal copying erode their consumer market, only a limited number of traditional consumer software publishers have agreed to license their software for use on school n·works.

While the price of network versions of software packages two years ago ranged from two to ten times the retail price of a single unit, most pricing arrangements are now about five times retail for a typical local area network license.

A number of economic and social issues are associated with local area and community-based networks. Some of these issues and related ones can be gleaned from the papers in this document. One of the major economic issues is the cost of purchasing, installing, and operating a network. Most of the early networks had price points that were exceedingly high. For the initial five demonstration sites in the METN project, state officials were able to obtain an agreement from IBM to provide both hardware and software to sites on loan. MacJANET, at the University of Waterloo, made extensive use of existing workstations, while the grassroots nature of CMS School-Net relied heavily on existing hardware. As an alternative to legislative appropriations to support expansion of METN, project staff developed a marketing concept, referred to as the Maryland Instructional Resource Center (MIRC), that would allow various groups and individuals to use the school network facilities after regular school hours to provide adult literacy, training, and other programs on a user-fee basis. The fees would be distributed among the local school district and participating vendors, including the telephone company, to create a reserve from which future expenditures for METN expansion could be drawn.

One of the reasons many school officials are interested in hardware-independent networks is that they can utilize existing hardware to experiment with local area networks, often for a total out-of-pocket cost of between $6,000 and $12,000. Some companies, such as VELAN, Inc., provide their software configuration on a 90-day approval basis.

Other economic considerations are installation, training, and operating costs. All parties involved in the METN project initially underestimated the cost of training and operations. While none of the sites budgeted for a full-time person to operate the network, in virtually every site at least one full-time operator was needed initially. It is noteworthy that both ESC and Tandy include as an option a full-time person to operate the network and train school staff for a period of nine months.

Another often overlooked cost associated with networks is the nonproductive time of regular teaching staff. For example, in its comparison of network versus stand-alone instructional configurations, the CATE study included that portion of a regular teacher's time spent moving students between the elementary classroom and the lab, as well as the additional time the teacher observed as the lab instructor taught the students. This was one of the factors contributing to the significantly higher cost per student hour in a computer lab network configuration than in a stand-alone situation (CATE, 1986). These relatively high costs, however, should be reduced dramatically in network setups that have "pods" physically located in various classrooms and integrated into curriculum areas and that rely on the classroom teacher for instruction.

Also differing among the projects are a number of social issues associated with local and community-based networks. For example, the original JANET system, which relied on IBM PC computers, and the follow-on MacJANET, which uses Apple Macintosh computers, were both designed to minimize teacher anxiety. Durance felt that a network would be an even bigger "black box" than computers themselves, and more threatening to the typical teacher. Hence, the network software was designed to be a tool for the teacher, assisting her/him to distribute software to workstations. The system was not designed to provide instructional management capabilities, track student progress, or provide electronic mail communication between students on the network. The METN project, on the other hand, increasingly relied on a management system (PC CLASS) that provided opportunities for teacher management of the instructional process. The CEMCORP METN configuration—and, to a lesser extent, the IBM configuration—was designed to facilitate student interaction within the network and, via modem, with other sites. The social issues related to teachers' roles in implementation differ significantly.

As Rogers notes, the CMS School-Net approach has been a sociological, not a technological, challenge. "A successful communications experience will occur only within the context of a carefully nurtured social situation that attends to certain critical sociological factors. It is possible to be a social isolate and be successful with a word processor, data base, or spreadsheet program. However, in a communications experience via modem, you must be part of a social structure. That is to say, there must be someone on the other end with whom you communicate."

The CMS School-Net approach was based on Riel's study of essential ingredients in successful networking experiences. These included the following requirements:

- There must be a task to be accomplished.
- Telecommunications must be easier and more effective than other means to accomplish the task.
- Participants must know each other.
- Participants must be committed to the task, and some degree of accountability must exist.

By all accounts, the CMS School-Net system has been successful. Even though the San Diego Teacher Education Center was closed following recent budget cuts in education technology, CMS School-Net continues to expand. Although the TEC-operated bulletin board has been discontinued, virtually all of its functions have been delegated to other nodes in the network, and a number of other groups (such as CUE) have agreed to contribute funds to pay for long-distance costs of the network. Despite CMS School-Net's success and its theoretical design, however, the opportunity to learn more about the sociological implications of telecomputing through in-depth research and evaluation appears to be lost for the present.

The design and implementation of Learning Link has, from an economic and social perspective, been very innovative. The iterative process used to design the system over time to meet user needs is somewhat unique. Reliance on off-the-shelf equipment and existing subscriber-school equipment bases, and the use of existing telecommunication infrastructures (for example, WNET data transmission capabilities) have resulted in a relatively low telecomputing cost. Moreover, the system software that makes it possible to access the services of other on-line data bases—such as MIX—provides opportunities to fulfill unique subscriber needs. Expanded consumer interest and satisfaction with Learning Link is reflected in the relatively large number of public television agencies and state departments of education, including the Software Communications Service, that have recently adopted Learning Link as an integral part of their multistate networks.

Interactive Distance Learning/Telecomputing

During the last two years, the number of students participating in distance learning projects has increased at a greater rate than has the number of students receiving instruction via microcomputer during the early 1980s. Distance learning models usually involve the following components: (a) interactive video, audio, and graphics; (b) satellite or other broadcast means; (c) a master teacher in one location; (d) students at remote locations (schools) with broadcast receivers; and (e) student access to microcomputers for drill and practice. The growth of distance learning projects over the last year can be attributed to a number of factors:

- Telecommunications, microcomputers, interactive video, and other related technologies are converging.

- Significant prior investments in broadcast ITV and cable systems have led to the availability of a telecommunications infrastructure within the states and regions, providing opportunities for distance learning with minimal startup costs and low marginal operating costs.

- Through the use of master teachers, distance learning often provides the only opportunity for students to receive courses that are now required in many states (because of increased standards for graduation) and to take advantage of the rapidly growing Advanced Placement Program.

- In rural, poor, and small districts facing consolidation, distance learning provides in many instances the only economically viable alternative for meeting state requirements, and thus survival.

Some of the same states that took a leading role in the microcomputer movement have initiated path-breaking distance learning projects. Distance learning in Utah has focused on language instruction in Spanish. Sponsored by the Utah State Board of Education, the Bonneville International Corporation, and IBM, this pilot study relies on low-cost, wide-coverage satellite transmission, master teachers, two-way audio, and one-way video, with opportunities for direct student interaction using microcomputers in a local area network. In Minnesota, seven small school districts have formed a distance learning consortium that relies on two-way fiber-optic video for transmission. Courses are offered in Spanish, French, accounting, and music. A major objective of this project is to access the increased quality of video, telephone, and computer transmission using fiber optics, which is more expensive than hard cable or microwave.

While some states have relied on traditional public broadcasting systems (Michigan's use of Central Education Network programming, for example), other states have established relationships with private firms. Texas has arranged with Ti-In Network Incorporated to provide distance learning to approximately 100 districts within the state. Ti-In provides instruction via satellite from master teachers in the TEA Region XX Service Center studio to the districts, which pay approximately $15,000 for equipment, monitors, printers, and telephone costs during the first year; subsequent annual costs are about $10,000. Course offerings cover a wide range of curriculum areas and include staff training and personal business offerings for teachers.

The papers by Bramble, Southworth, and Stoll describe three variations of interactive distance learning/telecomputing in different environments with somewhat different objectives. These papers raise a number of political, regulatory, and other issues that must be confronted if the effective use of this technology is to be realized. As Stoll notes, "Several policy and legislative issues have arisen as a result of this transformation process, because many of the current laws, policies, funding mechanisms, and regulations do not encourage or support the emergence of a new educational delivery system."

While expanded distance learning activities can be attributed directly to political issues (increased graduation requirements, focus on at-risk populations), distance learning is often politically threatening to existing institutions. Compounding the economic constraints that severely hampered Learn Alaska, a number of political issues were identified by Bramble that together represented a formidable force: (a) teacher union resistance because of the potential impact on employment; (b) college and university resistance due to perceived losses in attendance and hence revenue; and (c) growing opposition from public broadcasters. As Bramble accurately noted, to gain acceptance distance learning has to be implemented as a supplemental activity rather than as a replacement of existing functions; on the other hand, this political consideration results in extensive implementation, often without the potential being realized. In discussing the various Hawaii projects on international telecomputing, Southworth notes that a large number of associations and professional groups are involved in establishment and implementation. Such involvement of national and international associations represents a political force that can overcome some of the political problems that occur throughout various phases of the projects.

The economics of distance learning/telecomputing depends on the in-place infrastructure at both transmitting and receiving locations. Many of the New York state projects are projected to be extremely cost-effective because of existing infrastructures (for example, installed district-level cable, numerous transmission capabilities). On the other hand, Learn Alaska represented—in its early years—the creation of an infrastructure whose capabilities were expanded beyond instructional television to audio conferencing, which continued to operate despite the serious shortfall in revenue caused by the depressed price of oil and gas. The Learn Alaska experience is also a prime example of the difficulty of obtaining long-term funding support for a telecomputing/distance learning effort "once the glamour of new equipment purchases has faded."

Design and implementation of distance learning/telecomputing programs, more so than projects involving computers, has raised a number of regulatory issues—interstate as well as international. One of the major impediments to the use of distance learning in teacher training projects in New York has been the difficulty of providing credits for teachers receiving instruction, across state boundaries, from a master teacher not certified in New York. While it is possible to obtain waivers for specific telecomputing projects that transmit across national boundaries, existing tariff and other regulations can constrain expanded implementation. The Software Communications Service, a consortium of more than 15 states and Canadian provinces, is planning to transmit electronically—mostly through broadcast means—commercial software to participating states/provinces and school districts. However, the U.S. Department of Commerce has been unable to answer questions as to whether or not tariffs would be imposed on packages that are broadcast over national boundaries. Other regulatory problems regarding international telecomputing include the lack of standards for video transmission and length of school day requirements that vary among countries.

As Stoll notes, for a variety of technical, political, and other reasons, distance learning/telecomputing usually involves many entities (state education agencies, local districts, intermediate units, cable companies, private and nonpublic broadcast and transmission agencies), which in itself taxes the ingenuity of planners in developing organizational and managerial, not to mention political, innovations to ensure effectively implemented programs.

Closing Comment

This commentary purposely focuses on the nontechnical problems and issues associated with telecomputing at various levels, based on autnors' descriptions of projects and on subsequent discussions with them and other knowledgeable officials. As several of the authors note, the major challenges are in these areas, not the technology itself. If the potential of telecomputing, distance learning, and other projects is to be realized, now is the time to begin addressing these problems at the various policy levels.

Charles L. Blaschke

Over the last two decades, Charles L. Blaschke, president of Education TURNKEY Systems, Inc., has provided assistance and consultation to more than 1,000 local school districts, most state departments of education. several federal agencies, and numerous publishers and hardware manufacturers in various areas related to emerging technology use in education. TURNKEY has recently assisted more than 35 state education agencies in developing plans for technology use in instruction and telecommunications, and is currently assisting 18 states and four Canadian provinces to design a national consortium to aggregate markets for educational software.

20

Mr. Blaschke recently completed a study for the Office of Technology Assessment on the history of federal research and development support for education technology, and is presently conducting a study of current and projected computer use in the Job Training Partnership Act system for the National Commission for Employment Policy. A 25-year veteran of the computer-based education movement, he received his B.A. in economics from Texas A&M University and his Masters of Public Administration from the John F. Kennedy School at Harvard University.

21