DOCUMENT RESUME

ED 350 998 IR 015 813

AUTHOR	Tinker, Robert F., Ed.; Kapisovsky, Peggy M., Ed.
TITLE	Consortium for Educational Telecomputing: Conference Proceedings (Cambridge, Massachusetts, April 18-19, 1991).
INSTITUTION	Technical Education Research Center, Cambridge, Mass.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	92
CONTRACT	MDR-9153955
NOTE	67p.; For a collection of related readings, see IR 015 807.
AVAILABLE FROM	Technical Education Research Center (TERC), 2067 Massachusetts Avenue, Cambridge, MA 02140 ($9).
PUB TYPE	Collected Works - Conference Proceedings (021) -- Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Computer Networks; *Educational Change; *Educational Cooperation; *Educational Innovation; *Educational Technology; Elementary Secondary Education; Foreign Countries; International Communication; School Restructuring; Surveys; Telecommunications; *Teleconferencing
IDENTIFIERS	Canada; *Telecomputing; United States

ABSTRACT

Over 50 delegates from 32 states and 2 Canadian provinces attended this conference, during which 5 intensive working group sessions discussed, debated, and achieved agreement on a number of relevant issues concerning the role of educational telecomputing in school reform and restructuring. The conference proceedings begins with an overview of the current status of telecomputing in schools; an executive summary which presents seven conclusions and four recommendations for action from the five working groups; and an editorial guide to interpreting telecomputing issues by Robert Tinker, who addresses applications and requirements for educational telecomputing and organizational needs. Reports from each of the five working groups are then presented under these headings: (1,2) The Opportunity and Experience (Working Group I: Education); (3) Overcoming Barriers (Working Group 2: Curriculum and Teacher Support, and Working Group 3: Network Functions); (4) States and the Consortium (Working Group 4: Organizing a Consortium); and (5) Resources (Working Group 5: Implementing Educational Telecomputing). Each report covers the issues discussed and recommendations as well as the findings of a survey of all of the conference participants that relate to that particular group. A glossary, a guide to abbreviations, and a 14-item bibliography are also provided. Three appendixes contain a report on the EduCorp Statewide Survey that was conducted in 1990 to determine the status of K-12 telecomputing networks across the United States and identify the leaders responsible for those networks; a list of CET conference participants; and abstracts of the papers commissioned by the conference (see the related volume for the full text of these papers). (ALF)

Consortium for Educational Telecomputing: Conference Proceedings

April 18-19, 1991

Edited by
Robert F. Tinker
and
Peggy M.Kapisovsky

TERC

Consortium for Educational Telecomputing: Conference Proceedings

April 18-19, 1991

Edited by
Robert F. Tinker
and
Peggy M.Kapisovsky

TERC

2067 Massachusetts Ave.
Cambridge, MA 02140

TEL: (617) 547-0430
FAX: (617) 349-3535
Bob_Tinker@TERC.edu

Funding for the CET Conference and for the Proceedings was provided primarily by the National Science Foundation, grant # MDR-9153955. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

CONTENTS

ACKNOWLEDGMENTS

Any effort of this magnitude is dependent on the generous contributions of concerned educators too numerous to mention individually. We are particularly indebted to participants who took time out of busy schedules to attend the CET Conference; to the authors of the papers; to Bobbi Kurshan, who first suggested the need for this Conference, summarized the participant survey results, and managed the invitation list; to Beverly Hunter, who encouraged and facilitated our application for NSF funding of the Conference; to Connie Stout and John Clement, who have assumed leadership of the Consortium; and to the entire TERC staff, who gave a great deal of their time to make the Conference a success.

OVERVIEW

It is within our grasp in the not-so-distant future to have students and teachers participating actively in electronic communities of learners around the globe. Telecomputing[1] will be as easy as sitting down and turning on a computer. And, perhaps most importantly, telecomputing will expand and grow to make a substantial contribution to the quality of both learning and teaching.

The likelihood of these potentials being realized soon is high, but only if pre-college (K-12) educators and policymakers articulate a strong position now. There is little doubt that the technology underlying telecommunications will improve tremendously in the next few years, opening opportunities for profound changes in our society. And part of this impact surely will be on education.

However, the educational applications of most technologies lag behind their broader uses in society, and telecomputing is no exception. While corporations regularly transmit huge numbers of electronic files throughout the world, while electronic banking has become a reality, while over one million researchers network electronically, pre-college education has been only minimally touched by this revolution, left to languish in the pre-technological dark ages. To change this troubling state of affairs, we must implement what we already know about the applications of telecomputing to the pre-college environment, make a conscious effort to learn more, and build a coherent and articulate community of people who can address the critical issues of educational telecomputing.

For years many thoughtful educators have recognized that computer-based telecommunications is an exciting technology with multiple applications in education. Telecomputing offers a potentially inexpensive and valuable form of communications, giving educators access to databases, human resources, and curriculum materials that have the potential of transforming classrooms into new learning environments. It offers increased opportunities for cooperative and collaborative work involving not only teachers and students, but also professionals such as scientists, writers, and researchers; business and industry; and government agencies. Although the "glamour" and initial appeal usually focuses on long-distance links, the importance of local, even within-school collaborations cannot be overlooked.

Teachers are often isolated in their work, and networks offer them forums for discussion, mutual support, and access to experts in other fields. Through such

---

1 In general usage, the term "telecomputing" refers to computer-based telecommunications. The term is used in these proceedings to distinguish this form of telecommunications from video-based telecommunications.

electronic communities of professionals, teachers can share their own expertise and learn from each other as they implement changes in their classrooms.

Telecomputing provides an excellent tool for improving education, but more than technology is needed. A critical ingredient is the availability of high-quality databases, conferences, curricula, and other educational services. Without dynamic activities and services, the network is merely a skeletal structure. As networks expand the vast array of information available on demand and the engaging curricula that users can shape to their own needs, both teachers and students can shift away from the current emphasis on cramming "all the facts you need to know" by high school graduation. They can concentrate instead on a new vision of life-long learning, critical thinking, and problem solving.

Networks facilitate the "electronic publication" of curricula and therefore can make available to teachers a wider variety of materials than they would have otherwise. With electronic publication, the teacher, school, or district will be able to pull curricula material off the network, combine and modify it to fit their needs, and contribute their improved version back to the network users. Developers can take advantage of the features of networks and consider the movement toward more inquiry-based and problem-solving instructional activities as they are creating curricula.

Through telecomputing, teachers and students move beyond their classroom walls, collaborating with the nearby "real world" and with the global community and sharing curriculum materials and ideas. The result is accelerated access to new software tools, human resources, and cultural diversity. This supports the educational reform process already underway, empowering students to control their own learning to a greater degree, and changing the teacher's role. Even teachers who are eager to embrace new technology will need support, not only with technical matters, but with the best applications of this technology to teaching.

Teacher support and exciting curricula are inconsequential, however, if schools lack access to networks and are unable to take advantage of these possibilities. Widespread access is a necessary prerequisite for unlocking the potential of educational telecomputing. Making telecomputing universally accessible is an essential priority if we are to realize the potential of all children, but careful planning is necessary during this time of severe financial constraints.

Cost, of course, is a major obstacle to providing universal pre-college access to telecomputing. The associated hardware, software, modems, telephone installation, use charges, and teacher support expenses are major concerns for educators. The variable use costs often associated with telephone connections are a particular problem because they cannot be easily budgeted by schools. However, the major expenses in most educational uses of telecomputing today are the training and support costs which are often overlooked in planning. Telecomputing users in higher education are often unaware of the real costs of the telecomputing services available to them on campus and, incorrectly assuming that telecomputing is essentially free, fail to understand why pre-college educators are so reluctant to assume these costs.

Despite obstacles, improved network access is an achievable goal over the next decade. While it is highly unlikely that only one model of connectivity will emerge, one likely possibility is a hierarchy of networks in which classrooms of IBMs, Macintoshes, and compatibles are linked through a local area network to a host computer connected to Internet. The host computers might be located at the school, district headquarters, a nearby colleges, or in a collaborating business. These hosts will provide access to educational services offered anywhere in the system.

Low cost must be coupled with improved technology that makes it easier for teachers and students to access network services. Most telecomputing software is difficult and time-consuming to use. Busy teachers often grow impatient at delays and frustrated with cumbersome technology and thus drop out of network activities. Students are unable to send graphics and data easily to bulletin boards, electronic mail, and databases. These functions must be provided in a point-and-click environment on the computers now in schools, with access through low-speed dial-up lines. Major improvements in the functionality and friendliness of telecomputing are urgently needed as prerequisites to further implementation. Only then will users take full advantage of network programs and services.

To move toward achieving these goals, and believing that educational telecomputing will play a central role in school reform and restructuring, and that states, provinces, communications companies, and other major organizations need to coordinate their efforts, TERC organized the Consortium for Educational Telecomputing (CET) Conference. Held on April 18-19, 1991, in Cambridge, Massachusetts, and funded by the National Science Foundation (NSF), the Conference drew together more than 50 delegates from 32 states and two Canadian provinces. State Departments of Education were particularly invited because they will be vital in shaping the future of educational telecomputing, because they provide pre-college educational leadership for their respective states, have access to state university computational and computer network resources, and can tap state financial resources. During five intensive working group sessions, CET participants discussed, debated, and achieved agreement on a number of relevant issues, the highlights of which are presented here.

The Conference was designed to be short and intense in order to attract the most important decision-makers and planners, meeting Thursday afternoon and evening, and all day Friday. A set of commissioned papers and reprints distributed at the Conference provided introductory concepts to enable participants to address issues more efficiently. These papers were published in a companion volume[2]; they are abstracted in Appendix C of the proceedings.

These proceedings are structured to reflect the organization of the CET Conference. An Executive Summary presents an abbreviated overview of major Conference results.

---

2 Prospects for Educational Telecomputing: Selected Readings (1992). Robert F. Tinker & Peggy M. Kapisovsky, eds. Cambridge, MA: TERC.

This is followed by an essay by Robert Tinker, TERC's Chief Scientist and CET Project Director, designed to guide the reader through major issues underlying educational telecomputing. The findings of the five Working Groups are presented in succeeding sections and incorporate results of a participant survey conducted during the Conference. A Glossary and Guide to Abbreviations and a Bibliography are provided for reference.

Three Appendices offer more detailed information on three areas. Appendix A summarizes the results of a 1990 survey conducted by EduCorp Consultants; this survey of state Departments of Education, universities, public agencies, and private corporations was designed to provide data on the status of K-12 telecomputing networks across the United States and to identify leaders responsible for those networks. As such, it is an invaluable resource for those interested in pursuing opportunities in educational telecomputing. Appendix B lists CET Conference participants. Appendix C presents abstracts of the papers commissioned by the Conference. These papers offer substantive and detailed discussion about various practical and theoretical issues related to educational telecomputing and should be considered as an invaluable aid to individuals interested in pursuing specific subjects.

Executive Summary

The heart of the CET Conference was a series of five Working Groups that met twice on Friday and then reported back to a final plenary meeting. In these discussions, general agreement was reached in the following areas:

- *Educational telecomputing can make an important contribution to improving education.* It provides low-cost access to communities of teachers and students, to data, and to other resources, all of which could help make important improvements in education.

- *ALL teachers and students should have ready access to inexpensive and easy-to-use telecomputing resources as soon as possible.* Universal access is an achievable goal over the next five years and a necessary prerequisite for unlocking the potential of educational telecomputing.

- *A substantial body of information and experience on educational telecomputing is available now.* The educators represented at the Conference have the experience needed to implement large-scale, effective educational telecomputing programs. However, this knowledge needs to be made more widely available through compiling information and undertaking and publishing additional research.

- *Improved technology must be implemented that makes it easy and efficient to access network services.* Most telecomputing software is difficult and time-consuming to use. Major improvements in the usability and functionality of telecomputing are urgently needed as a prerequisite to further implementation and research.

- *Greatly expanded educational resources must be made available to students and educators over telecomputing networks.* Telecomputing provides access, but a range of high-quality resources—databases, electronic conferences, curricula, and other educational services—needs to be made accessible.

- *Training and support services must be made available.* Telecomputing requires some local technical expertise, but in order to achieve the larger goals of improved approaches to teaching and changes in the educational culture, both technical and educational assistance must be put in place.

- *Leadership.* Better, clearer leadership at all levels and stages is needed. The case for telecomputing must be made on the national stage, with better coordination among people and institutions facing similar problems and having similar aims.

The Conference recommended the following items to be accomplished first, before large-scale implementation can be contemplated:

- *Establish connectivity with the Internet.* The Internet presently reaches all fifty states, offers extensive local connectivity, and already connects the nation's postsecondary institutions as well as much of business and industry. Connection to this network will ensure a common, low-cost pathway for educators at all levels.

- *Provide improved functionality.* K-12 users need to be able to send text, graphics, and data as electronic mail, as contributions to bulletin boards, and as additions to databases. These functions must be provided in a point-and-click environment on the computers now in schools. This access should be practical and low-cost through low-speed dial-up lines.

- *Support research and development in network applications for curriculum, instruction, and administration.* A wide range of experiments with educational and administrative applications of telecomputing to education is needed.

In addition, the Conference strongly agreed with the premise that there was a need for developing and expressing the telecomputing needs of K-12 education. They called for educators to:

- *Establish a consortium of institutions engaged in educational telecomputing.* This consortium is needed to coordinate research, development, and implementation of educational telecomputing, and to bring its importance to the attention of educational policy makers and the public at large.

The process of creating the consortium is well underway. There was a follow-up meeting on June 23, 1991, at the National Educational Computing Conference in Phoenix where goals, objectives, and organizational issues were discussed. The group selected the name "Consortium for School Networking" (CoSN). A board was appointed and met in Pittsburgh on January 9-10, 1992, creating bylaws, a financial plan, and first-year goals[3].

---

3 For more information, contact John Clement at CoSN, (202) 466-6296. jrc@bitnic.bitnet

INTERPRETING TELECOMPUTING ISSUES: AN EDITORIAL GUIDE

by Robert F. Tinker

As project director and CET Conference convener, I have tried to be an impartial observer of the telecomputing scene, to not impose my views on participants, and to ensure that this report accurately reflects the various positions and stands represented at the Conference and in subsequent discussions. After all that impartiality, perhaps I have earned the right to mount my soap-box and give my interpretation to all who will listen. This editorial, then, represents my opinions, and not necessarily those of TERC, the NSF, or Conference participants. I call this an editorial guide to emphasize that, while opinionated, I hope it will help guide the reader through the various cross-currents present.

Applications of Educational Telecomputing

As many thoughtful educators have been saying for years, computer-based telecommunications represents a vital and expanding technology with virtually limitless applications in education. It offers a form of communication that is potentially very inexpensive and valuable, giving access to databases, human resources, and curricula that have the potential of transforming the classroom. Telecommunications technology will improve tremendously in the next few years, creating what many observers agree will be profound changes throughout society. Part of this impact will be a significant improvement of education.

The application of most technologies to education lags behind their broader use in society, and telecomputing is no exception. The time has come to apply what we already know about the educational applications of telecomputing, make a concerted effort to learn more, and quickly make educational telecomputing a resource that could begin to reverse the deterioration of our schools.

It is not surprising that CET Conference participants agreed with this assessment. The many projects documented and the tremendous interest at the state level attest to the broad interest in this technology. The following are the important potential contributions of educational telecomputing:

- Supporting teachers and enhancing their work by providing forums for discussion, mutual support, and access to experts.
- Supporting collaborative student projects such as electronic newspapers and science projects that involve sharing data.
- Providing a vehicle for the electronic publication of curriculum material, especially network-based curricula.

- Facilitating long-term pairings of North American schools with schools around the globe to support better international understanding.

- Providing students and educators with access to data, images, and reference material of virtually limitless quality and scope.

- Facilitating the involvement of scientists and businesses in education.

- Supplementing a wide variety of administrative and professional communications needs.

- Reducing teacher isolation by providing access to communities of professionals with similar interests and needs.

Given these potential advantages it might seem surprising that telecomputing is not more widely used and that the numerous projects that have adopted telecomputing with great enthusiasm have not flourished at the pre-college level. Why is telecomputing not already an integral part of teacher support networks? Why is it not widely used in student projects and research? Why do few educational research and development projects use telecomputing to exchange manuscripts, seek feedback from the field, and communicate with collaborators?

One answer is that educational telecomputing projects are limited by the poor quality of the technology. Most telecomputing technology available to educators is anachronistic, user-unfriendly, expensive, and insufficiently powerful, making the act of telecomputing unpleasant and unnecessarily restricted. When telecomputing is difficult, limited, and frustrating, busy educators and students will tend to delay using it, fall behind in answering electronic mail, and withdraw from ongoing network activities. Most available technology has not reached the point where the benefits of networking are outweighed by difficulties large and small.

Accessing and sharing information over digital networks should be no more difficult than saving files to disk from an icon-driven operating system. Students and teachers should be able to access and share a broad range of information in text, numerical, and graphic form between the common microcomputers. These operations should be so economically feasible that cost is only a minor consideration. When telecomputing technology is powerful, flexible, easy to use, and economical, educational applications will flourish.

Requirements For Educational Telecomputing

The four functions most needed in educational telecomputing are universal access, interactive graphics, support of commercial services, and low cost. To achieve these, we should be willing to accept limited performance and responsiveness for most pre-college users. The reasoning behind these assumptions is amplified below.

You Cannot Have It All

One problem with asking a committee for recommendations is that any committee has difficulties making hard choices in a resource-limited world. Not surprisingly, this was true of CET Conference participants as well. Some recommendations were incompatible: One Working Group recommended high bandwidth, direct connections supporting high-resolution graphics and video, while another recommended universal student access. The fundamental fact is that it is impossible for all 42 million pre-college students in the United States to have access to high bandwidth applications. One can either give such access to only a few fortunate students or give more modestly scaled access to *all* students. In a society where the most intransigent educational problems are faced by the poorest students, there seems no question about where national educational priorities lie: *We must plan a system that can provide limited connectivity to all students, as quickly as possible.*

Of course, limited connectivity would be meaningless if only high-bandwidth educational applications were of value. However, this is not the case. With careful educational and technical design, limited telecommunications offers a great deal to education. Our highly successful NGS Kids Network transfers only 1 Kbit per child per month. Other educational projects might need more data transfer, but by foreswearing pictures, sounds, and videos, 1K per student per day is more than sufficient and represents a practical cap. Of course, it would be wonderful to have no limitations to students' access to technology, but pictures requiring large files, sounds, and videos are not necessary for a broad range of educational applications and are certainly not economically achievable for all students in the short term. The educational telecomputing system we design should be able to support higher levels of performance for those who need it, but its primary goal should be universality, and that requires clever use of limited bandwidth on the order of 1K per student per day.

Anyone committed to extending university-level telecomputing to the pre-college level is rightfully daunted by potential usage. There are over 42 million pre-college students in the United States, and if only 1% of these signed on to a remote computer for even a modest session, the existing Internet system, and probably the planned National Research and Education Network (NREN) as well, would be summarily brought to its knees. However, the problem becomes more manageable if pre-college needs are viewed more realistically. For example, students could work off-line and be restricted to modest file sizes. Suppose that every U.S. student transmitted the daily 1K message suggested above, and that the only connect time was to transmit or receive that message at the maximum rate of a remote modem. This would generate about 0.5 Gbits daily, which, spread out over 24 hours, would come to 5Mbps average total communications load. At any one time only 10,000 user computers would be connected, requiring only a few thousand small host computers connected to the network. This would be truly insignificant in the planned NREN system, which envisions multi-Gbps capacity at least 1,000 times greater, and tens of thousands of large computers.

Software Requirements

Software used in pre-college education must have a point-and-click user interface and access to graphics, data, electronic mail, bulletin boards, and databases. The compromises in user interfaces that are acceptable in research or commercial environments are not acceptable to busy teachers who may not be comfortable with technology and certainly cannot take time to learn specialized, command line-driven software. In addition, the software must take into account problems that are important to educators at this level, including the need for curriculum integration and the extremely limited funds available.

If telecomputing is to serve all students, interactive graphics in general and a responsive graphical user interface in particular cannot be compromised. To be accepted widely and used regularly, telecomputing software must have the sort of "point and click" user interface that has become standard in all modern microcomputer applications. Most telecomputing software lacks this simplicity, requiring one to consult regularly a manual and leading too often to frustration; at best, telecomputing software is slow and cumbersome. The poor quality of telecomputing software is a persistent complaint of teachers participating in telecomputing projects and is a major contributor to the high failure rate of educational telecomputing projects.

A graphical user interface is not compatible with the design of most telecomputing systems, which treat the user's computer as a dumb terminal. To support a good graphical user interface, there needs to be a substantial program running on the user's computer that interacts with the network system automatically. This architecture requires user software with similar functions for each of the major computers used in schools.

Given the importance of visuals in communicating complex ideas, some form of graphics is necessary for educational telecomputing. To meet the requirement of limited bandwidth, the graphics should be encoded using a display list in common use. With such a list, one transmits high level information about how the graphic was drawn, rather than bit-by-bit information about how it appears. Students then have easy access to graphics display software which can generate the graphics from the display list.

Similarly, if telecomputing is to be useful in mathematics and science education, the storage, retrieval, and transmission of numerical data must be facilitated and easily displayed in tabular or other graphical formats. Spreadsheet data transmission standards should be used, but a data analyzer and graphing application that is simpler than a spreadsheet are needed.

Electronic mail and bulletin boards provide the minimum means of communication—the former for sending a message to a known user, the latter for sending to an unknown user. Both electronic mail and bulletin boards should be capable of handling the same kinds of messages, including graphics, text, and data. User software is needed to simplify the creation, addressing and sending, retrieving, and reading of these messages.

Likewise, database functions also need to be supported. Like structured bulletin boards, this is difficult to achieve while restricting connect time. As is done in PsiNet, the local computer needs to maintain sufficient information about on-line databases so the user can generate queries off-line, which are then acted on in batch mode when the user connects to the network. If connect time to the database host is not a constraint, the software should also support on-line searches.

One of the unusual requirements created by many projects is the need to permit easy, but controlled, contributions to a database. This would, for example, facilitate one school setting up a database of watershed pollution indices to which other students could contribute.

Funding Sources: Commercial versus Public Sources

It would be a wonderful world if all educational services were free, and the current research-based networks are designed from this perspective. Within the Internet, universities provide telecomputing services for their community in the same spirit as they provide student and faculty free access to libraries. And while some Internet providers are granting free pre-college access to the Internet, this cannot be a solution in the long run. As use begins to reach its potential, someone must pay the real costs of pre-college access, and universities cannot bear this expense.

Further, there are costs associated with educational telecommunications that go far beyond the costs of information transfer. For instance, many teacher networks flourish only when there are moderators to facilitate the conversation: an expense that can easily exceed the telecommunications expense. One year MIX, the McGraw-Hill Information Exchange, was the leading provider of educational telecommunications; the next year it was out of business, largely because McGraw-Hill provided generous and effective moderator services but could not generate sufficient revenue to pay for them. Some services are quite expensive and need to be offered on a fee-for-services basis, which is not compatible with the Internet design philosophy.

There are two possible ways of funding educational telecomputing services: either some donor or government agency must pay, or the services must be commercial, with the end user paying. The educational telecomputing system put in place should accommodate both means of funding. The end user should be able to select some externally supported activities that are free to the user and select others that require subscription or some other form of payment. It seems obvious that, just as the medium of paper supports both free state-financed curricula and commercial texts, so too must the medium of telecommunications. Were we to rely only on external funding, many of the possibilities of the medium would be overlooked and the vitality of competition would be lost. Were we to rely only on competition, innovation would be lost and risk-taking curtailed. Already most of the widely used educational telecomputing projects—the NGS Kids Network, the AT&T Distance Learning Network, and the various weather services—are run on a subscription basis. Clearly, the educational telecomputing infrastructure we build must continue to support both options.

No matter who pays, there must be economic pressures for the user to contain costs or else there is no incentive to economize, to stay within the proposed cap. For instance, the NGS Kids Network software provides the option of combining student messages in a single batch and sending them out together at night. With no economic incentive to do this, however, each student sends his or her own message as soon as it is ready.

Thus, one reaches a conclusion that initially sounds surprising but makes sense upon closer examination: The educational telecomputing infrastructure must support non-profit and for-profit educational services side-by-side.

Cost Considerations

Underlying the foregoing discussion is the problem of cost. If educational telecomputing is to be universal, the actual, real cost of educational telecomputing must be low. For comparison, there is probably an annual per-student capital investment of roughly $10 in microcomputers and $50 in textbooks. The maximum acceptable cost of educational telecomputing lies somewhere in this range, and probably at the lower end until there is a wealth of educational services available that could begin to displace texts. Again, for comparison, the cost of commercial telecommunications services used in education are in the range of $5-15 per hour, so one hour of commercial connect time per student per year is currently an upper limit for most students. This low level is not acceptable, because there is little educational value in such limited access.

The great attractiveness of the Internet is that it is free. Of course, nothing is free, but if an arrangement can be made to carry a limited amount of pre-college traffic on the Internet at no cost to pre-college users, then a major cost factor to pre-college education will have been removed. This is essentially a trade of the political clout of pre-college education for modest access of education to the long haul capacity of the Internet. This trade will work only so long as the pre-college load on the system is negligible. When this traffic becomes more substantial, pre-college education will have to pay its fair share of the costs, and there is little reason to believe that these costs would be substantially less than commercial costs because all providers use essentially the same technology.

There are actually two issues associated with pre-college use of the Internet. Internet (with a small "i") is a standard for message exchange and addressing. As this standard is increasingly used, it is reasonable to adopt it for educational software. In addition, there is the Internet (with a capital "I"), which consists of the existing interconnections between the NSF Net backbone, regional networks, universities, and businesses. This is sometimes called the interim NREN, with the implicit assumption that NREN will be built upon and improve the existing Internet.[4] The Internet is most likely the best network for pre-college telecomputing, if there is substantial federal funding for its use by pre-college users.

Cost considerations demand that the primary access of educational telecomputing to the network be off-line. A student could easily tie up a line to a remote computer for an hour to generate a 1K electronic mail message on the remote editor. The same file could be generated on a local microcomputer and sent in 10 seconds, requiring 360 times less communications time and cost. The educational telecomputing infrastructure must be designed to take advantage of this huge potential cost reduction.

Organizational Needs

The CET Conference was designed to explore whether a new organization was needed to address the particular concerns of educational telecomputing. The answer seemed to be a resounding YES, because of the unique needs, perspectives, and concerns of pre-college education that set it apart from other telecomputing applications.

A Two Cultures Problem

The difference of interests, needs, attitudes, and values between university and pre-college users of telecomputing sometimes makes communication between the two groups difficult. This difficulty is exacerbated by the greater technical experience and general volubility of many university-level spokespeople that make it difficult to hear pre-college voices.

The Internet grew out of the computer science research community, where real hackers use command lines, not menus. The broader academic community tolerates the resultant hostile user environment because professional communication and joint publications are the lifeblood of the academic culture. In addition, a high degree of technical expertise is available on most campuses, so there is usually someone to turn to for help with the more incomprehensible aspects of academic computer systems.

In contrast, a high level of collegial communication is not important for most pre-college teachers. As one participant at the CET Conference put it, two pre-college teachers in the same field teaching next to each other often do not share professional concerns, so after a grueling day of six classes there is little motivation to use an unfriendly computer to communicate with a teacher elsewhere. Thus, there is a difference of cultures between university and pre-college educators.

---

4 There are commercial networks and a Department of Defense network that use the internet standards, so the term Internet is somewhat ambiguous. Following common use, I have used "the Internet" when referring to the interconnected university-based networks.

Beneath this conflict of cultures lies a deeper conflict of interests. In one sense, the supercomputers and NREN are solutions hunting for problems. It stands to reason that investing in these powerful technologies will be important in the long run, and, having done so, it is vital that compelling applications for all that power be found. For those invested in these resources, pre-college education is a promising new application area because it represents a huge potential market.

However, attacking educational problems from the perspective of searching for applications of a technology can be a perilous undertaking. Because such large sums and potential profits are at stake, there is the danger of education being used rather than served. The easiest solution for those having the technology is simply to apply the technology as-is. Hence, the possibility exists of having education saddled with the wrong technology and missing the real contributions that technology could make. There is also the potential of showmanship that solves no serious educational problems—for example, the free supercomputer at the high school, used by only a few students and not provided with maintenance funding. Educators have limited resources and even less patience for hollow efforts that leave the huge, depressing problems of public education untouched.

Educators are wary of technological enthusiasts who come around selling any sort of technology. Communications technologies have much to offer education, but its uses must proceed from actual educational concerns and must realistically address these concerns. Hence, there is a need for an organization to represent the interests and perspectives of pre-college educators.

The Fledgling CoSN Organization

The CET Conference achieved its major goal of stimulating the development of a consortium of educational institutions focused on pre-college telecomputing applications. Named the Consortium for School Networking (CoSN), the group started at the conference has become established and is beginning to define its mission.

CoSN could play a major role in improving education by representing pre-college educational telecomputing interests and stimulating the provision of quality telecomputing-based learning at the lowest possible cost to schools. CoSN could coordinate the establishment and interconnection of networks and hosts. It could also create and disseminate educational telecomputing software that meets the requirements set out above, both by pooling funding available to members and by seeking additional funding from public and private sources. Finally, it could also pool resources to create curricula and other network-based educational tools that would be made available at cost to members.

The establishment of CoSN represents a novel development. It is a conscious attempt to employ a strategy of pooling interests and resources available to states, provinces, corporations, and others interested in education to create and share software, curricula, and expertise. It envisions public dissemination mechanisms that could result in substantial savings at the school level.

CoSN has selected the following as its core functions for its first year:

- **Advocacy** and information for policy makers about the K-12 educational uses of networking and resources. CoSN will define and articulate the telecomputing needs of education.

- **Information provision** to the K-12 community about telecomputing developments and about participation in telecomputing efforts.

- **Policy identification** and development. CoSN will identify issues of importance to K-12 telecomputing, write monographs on the issues, foster discussions, and, if possible, reach a consensus view.

- **Technical issues.** CoSN will undertake consensus-building within relevant educational and technical communities.

- **Liaison** with corporate, vendor, and resource providers for planning and development.

If additional funding can be located, CoSN will also undertake:

- **Network connections.** Creating local and regional hosts inexpensively interconnected through a variety of networks, including the Internet.

- **Curriculum development.** Sharing expertise in creating telecomputing-based curricula and also sharing material and approaches developed.

- **Teacher support.** Developing dissemination and support materials and workshops and sharing the costs of developing and offering these materials.

The following are potential benefits to members of CoSN:

- **A policy platform.** CoSN could be an important group of telecommunications users, providing international leadership that will be particularly important as NREN, the National Research and Education Network, is being established.

- **Pooled curricula.** A substantial body of telecomputing-based curricula could be created within CoSN and made available to members.

- **Network interconnection.** Members could coordinate the establishment and interconnection of hosts supporting CoSN, taking full advantage of existing regional, national, and international networks.

- **Cost sharing and reduction of duplication.** Shared development and dissemination of telecomputing activities could reduce costs and duplication for CoSN members.

- **Unlimited access to CoSN software.** Collaboratively developed software could be licensed for unlimited educational use by members.

Members have the capacity of establishing substantial dissemination and implementation efforts within their jurisdictions. These efforts could include duplication and dissemination of CoSN user software; establishment of multiple, interconnected hosts; duplication and dissemination of curriculum material; identification of telecomputing user support staff; establishment of related curriculum development and teacher support programs; and coordination of groups contributing to educational telecomputing.

If CoSN grows to the point that it can assume the much-needed national leadership role in coordinating the development of educational telecomputing, then the CET Conference will have been a resounding success.

THE OPPORTUNITY

Educational telecomputing has a major role to play in supporting reform and revitalizing education. Hence, the first and clearest conclusions from the Conference emphasize the importance of this role and the necessity of bringing the benefits of educational telecomputing to all students and teachers:

- *Educational telecomputing can make an important contribution to improving education.* It provides low-cost access to communities of teachers and learners, to data, and to other resources.

- *ALL teachers and students should have ready access to inexpensive and easy-to-use telecomputing resources as soon as possible.* Universal access is an achievable goal within the next five years and a necessary prerequisite for unlocking the potential of educational telecomputing.

The most important applications of educational telecomputing are teacher support, international education, database access, and student collaboration. The major barriers are teacher support, costs, difficulty of access, and lack of curricula. A major hidden cost of educational telecomputing and, therefore, a barrier to its wider use, is the human cost of facilitating communications.

This section expands on these issues, presents arguments favoring educational telecomputing, and describes trends in telecomputing costs and services.

Working Group 1: Education

Working Group 1 considered the role of telecomputing networks in pre-college education and the barriers that need to be eliminated before telecomputing can achieve its full potential. The group was composed predominantly of state and provincial educational facilitators and was chaired by Jim Ellis of Biological Sciences Curriculum Study.

The introduction of educational telecomputing raises issues, is subject to many constraints, but also gives rise to new opportunities. These three areas are discussed below.

Issues

Inequity. In a period of severe resource constraints, educational telecomputing must bridge diverse cultures and address the needs of at-risk students while being available to all students in all schools.

Teacher support/development. There are problems in getting teachers to act on the potential of educational telecomputing as part of the movement towards collaborative learning, inquiry-based learning, and curricular restructuring. The major hurdle is helping teachers change their teaching methodology to accommodate educational telecomputing.

Cost/effectiveness. In order to justify outlay of funds and resources, objective proof is needed of the contribution that educational telecomputing is making to the learning process.

Curricula and assessment. Examples of curricula and guidelines on assessment are needed. Such concrete examples will aid decision making.

Constraints

Services and information. There is insufficient technical and educational support for teachers wishing to use telecomputing in their classrooms, as well as insufficient training support. Unbiased sources of information about educational telecomputing are lacking.

Technophiles and technophobes. The education world still seems split into those who show an excessive love and those who show excessive fear of new technology. Either extreme can adversely influence progress. Too few teachers are using educational telecomputing sensibly and confidently to show a useful alternative to the extremes.

Culture. There is a predominant culture among teachers that favors the independence/isolation of the school—and even of the classroom. Added to this, teachers are at a very low state of morale and are disillusioned by constant calls to change, often in incompatible directions. The movement for change is usually from the top down to the teacher and not inspired from any ground swell of need in the classroom. Teachers' perceptions of priorities may well be different from those who are advocating particular changes.

Existing curricula. There is currently very little fit of vision between existing curricula and those curricula that become possible with educational telecomputing.

Finance. Necessary equipment, services, and the establishment of training programs to support change are difficult to get funded in the present economic climate.

Opportunities

Communication. Access to educational telecomputing can change the culture of isolation and enable sound collaborative learning and dynamic collaborative curricula.

Efficiency/productivity. Educational telecomputing technology provides teachers and administrators with tools for better record keeping and data sharing and encourages student enthusiasm and learning productivity.

New roles. Educational telecomputing technology causes teachers to re-examine traditional teacher/learner roles (especially with the ready access to information from databases, other teachers, other experts, and so forth).

Industrial practice. In using the new technologies, teachers can learn from current industrial practices and also provide their students with experience of current practices in the "real" world.

Information equity. By providing ready access to information, educational telecomputing can shift the emphasis for the learner from acquiring knowledge to using knowledge. If there is equal opportunity for all teachers/students to have access to educational telecomputing, then all potentially will have equal access to the same information. Access to powerful databases and on-line support can dramatically enhance teacher development.

Recommendations

These recommendations are addressed to government, to TERC, to any consortium formed, and to individual Conference participants:

Establish clear, realistic purpose and goals for educational telecomputing that are linked to educational needs.

Use telecomputing to achieve the "new vision" of education in the work place, in the information society, and in liberal education. This vision is one of life-long learning, critical thinking, cooperative learning, information literacy, quantitative skills, and knowledge utilization.

Do not promise more than you can deliver. Plan for incremental change over time.

Overcome financial constraints to establish *equal access to, use of, and benefit from educational telecomputing.*

Balance the need to support cultural diversity with the need to nurture a collaborative culture within schools and across the nation.

Emphasize school improvement and teacher development equally. School improvement cannot be achieved without teacher development. Recognize that successfully integrating educational telecomputing into instructional programs depends upon effective teacher development programs.

Integrate telecomputing into curriculum products where appropriate. Telecomputing-related curricula with a modular structure must be developed to accommodate those schools with only limited access to the technology.

Encourage assessment alternatives to accommodate and use educational telecomputing.

Support as many as possible of the makes and models of computers commonly found in schools.

Survey Results

A survey was distributed to all Conference participants. The results of the questions relating to the primary potential benefits of educational telecomputing are summarized below.

Telecomputing activities that hold the greatest promise for growth are those that help schools meet their instructional goals and that can change dynamically to meet user needs. In particular, respondents indicated that methods of telecomputing that have the greatest promise for growth include electronic mail (e-mail), bulletin boards, distributed conferencing, powerful new user workstation tools, classroom-to-classroom exchanges, bilingual communications, CD ROM access, on-line access to information resources, uses that combine different types of media and data, and remote connections for student-teacher and home-to-school linkages. Those activities that promote administrative efficiencies, professional development, and research uses were also listed as holding promise.

Educational telecomputing is now, or is planned, to support and facilitate educational reform and reshape the educational mission; to support curricular and instructional changes and restructuring efforts; to further technological integration; to help achieve equity and global education goals; to meet learner needs, enhance student attitude and self esteem, and decrease drop-out rates; to empower staff and students and support teacher needs; and to further school/business partnerships.

The primary potential benefits of educational telecomputing involve improving education directly in the learning environment. Also often mentioned was the importance of telecomputing in supporting teachers and in creating a community of educators. The goals of educational telecomputing commonly identified by participants include:

Learning Environment

- to improve the quality of learning in schools;
- to provide tools that help students engage in creative and reflective thinking, and knowledge construction;
- to meet the learning needs of all types of students;
- to provide equal and user-friendly access to quality instructional and research resources at the lowest possible cost;
- to provide worldwide access to high-quality information, and curricular and human resources;
- to increase opportunities for collaborative, cooperative learning;
- to increase the motivation of students to learn, to write, to think, and to analyze;
- to provide an opportunity to access otherwise inaccessible information; and
- to support curriculum and instruction rebuilding.

Teacher Support

- to help teachers make the transition from information provider to facilitator;
- to enhance teacher development and productivity;
- to promote idea exchange among educators;
- to reduce teacher isolation and to increase contacts with institutes of higher education; and
- to explore instructional applications not otherwise possible in the traditional classroom.

Community

- to stay on the leading edge of technology;
- to better prepare students to work in an information age;
- to expand exposure to practical telecomputing applications; and
- to develop a statewide telecommunications infrastructure that supports partnerships among business, community, government, schools, and institutes of higher education.

EXPERIENCE

The CET Conference participants concluded that there was sufficient experience to effectively apply telecomputing technology broadly:

- *A substantial body of information and experience on educational telecomputing is available now.* The educators represented at the Conference have the experience needed to implement large-scale, effective educational telecomputing programs. However, this knowledge needs to be made more widely available through compiling information and undertaking and publishing additional research.

To avoid dooming ourselves and others to repeating history, we asked participants to summarize what experience their states have had with educational telecomputing.

Survey Results

Several states presented detailed information about the projects (including pilot projects) currently operating in their states.[5] These ranged from full-scale statewide networks to classroom-to-classroom activities in foreign languages to bulletin board and database services.

These pilot projects and programs have relied on the expertise, support, and help of state government agencies, departments of education, universities, a few telephone companies, national agencies, grass roots organizations and a few businesses, and the commitment of computer-using educators to offer leadership, ideas, advice, technical support, reduced charges, equipment, and more.

[5] Current as of April 1991.

Telecompuing Projects by State[6]

State	Activity
British Columbia	SIPT
California	Kids2Kids, Connected Telecultures
Colorado	Projects with schools connected to NSFnet through Supernet, TERC Star Schools Project
Connecticut	Variety, Global studies and research, on-line database services, e-mail and bulletin boards, bilingual/foreign language networking
Florida	FIRN, plus many related projects
Indiana	ESD (Electronic School District)
Minnesota	Classroom networking projects
Nebraska	AMIDNet/NSFnet node
New Mexico	Variety, EDUCOM K–12 Networking Project
Ohio	Learning Link, EduLink, INFOhio
Rhode Island	Math/Science Gifted and Talented Electronic Network, Mathematics/Science Telecommunications Network, and Dialog pilot grant.
Vermont	VTEDNT, the Portfolio Assessment Project, "Our School," and Math and Science Resource Database
Virginia	VAPEN, pilot projects in National Geographic Kids Network and TERC Star Schools Project, plus projects linking public schools to the Internet
Washington	Pacific NW Star Schools Project, business partnerships

6 For more information about any of these projects, contact Bobbi Kurshan, EduCorp, 4940 Buckhorn Rd., Roanoke, VA 24014. (703) 774-0193. Kurshan@vtvm1.cc.vt.edu

Overcoming Barriers

Conference participants agreed that the major barrier to wider use of telecomputing in education is the difficulty of using most telecomputing software. Improved technology that makes it easy and efficient to access network services must be implemented. However, the technology is only part of the solution—educational services are needed on the network and teachers need help to use these resources effectively.

General agreement was reached on these issues:

- *Improved technology must be implemented that makes it easy and efficient to access network services.* Most telecomputing software is difficult and time-consuming to use. Major improvements in the usability and functionality of telecomputing are urgently needed as a prerequisite to further implementation and research.

- *Greatly expanded educational resources must be made available to students and educators over telecomputing networks.* Telecomputing provides access, but a range of high-quality resources—databases, electronic conferences, curricula, and other educational services—needs to be made accessible.

- *Teacher training and technical support services must be made more widely available.* Telecomputing requires some local technical expertise, but in order to achieve the larger goals of improved approaches to teaching and changes in the educational culture, both technical and educational assistance must be put in place.

- *Leadership.* Better, clearer leadership at all levels and stages is needed. The case for telecomputing must be made on the national stage, with better coordination among people and institutions facing similar problems and having similar aims.

This suggests the priority items that need to be accomplished before large-scale implementation can be contemplated:

- *Provide improved functionality.* K-12 users need to be able to send text, graphics, and data as electronic mail, as contributions to bulletin boards, and as additions to databases. These functions must be provided in a point-and-click environment on the computers now in schools. This access should be practical and low-cost through low-speed dial-up lines.

- *Support research and development for curriculum, instruction, and administration in network applications.* A wide range of experiments with educational and administrative applications of telecomputing to education is needed.

The best use of any new technology, including educational telecomputing, involves new curricula and coordinated teacher support programs. The curricula should support the larger goals of educational reform: school restructuring, teacher professionalism, student empowerment, and intercultural collaboration. Little material that uses educational telecomputing to support these goals is available and much more needs to be developed and tested. The network should be used for materials development, sharing, and publication to reduce the costs of this effort.

TERC has been working on a software design, Alice, which addresses the technical issues raised. A mock-up of Alice was demonstrated to participants, and TERC proposed to develop Alice for Consortium members as a way of overcoming the software problems identified.

Because overcoming barriers was such an important topic, two Working Groups discussed related issues. Group 2 addressed curriculum and staff development issues, while Group 3 considered the software barrier and the functionality required. Facilitators were Glen Bull of the University of Virginia (Group 2) and Cecilia Lenk of MCET (Group 3). The reports of these groups follows.

Working Group 2: Curriculum and Teacher Support

Issue

A plethora of information services often overwhelms teachers who have access to these services and are seeking to create instructional materials.

Recommendations

CET should provide a mechanism to allow users to obtain on-line information easily through key-word searches.

CET should encourage development of new model programs for specific topic and skill areas, which take advantage of existing networked resources and databases.

The focus of pre-service and in-service staff development activities at the state and local levels should include specific examples tied to topic and skill areas.

Issue

There is no incentive in the current curriculum to include telecomputing as an instructional tool; current curriculum guides provide little information about the uses of telecomputing.

Recommendation

School districts should be encouraged to take advantage of the power of telecomputing in their curriculum and assessment design.

Issue

Limited network access (due to lack of hardware, variations in hardware, and distribution across grade levels and disciplines) is an impediment to instructional uses of telecomputing.

Recommendations

Recommended architectures that provide access to the network for various school circumstances should be developed.

Staff development and planning for telecomputing must address various strategies to accommodate the fact that types and numbers of computers differ at elementary, middle, and high school levels.

Issue

Teachers tend not to provide tools to students that they themselves do not use.

Recommendations

Make use of the telecommunications program simple, intuitive, and above all, fun!

Provide activities dedicated to:

- professional development (access to research, classroom activities, etc.)
- teacher instructional materials (lesson plans, etc.).
- encourage professional organizations to use networks.

Issue

Teachers do not have time during their schedules to develop new telecomputing applications.

Recommendations

Create (ready-to-use) structured curricula with options for teacher-developed extensions.

Plan application development workshops and provide incentives for staff to attend (consider royalties, release time, etc.).

Provide leadership training and/or materials for implementation that suggests:

- initial activities centered around specific content-related telecomputing activities
- ongoing support throughout the year
- ways to monitor and assess effectiveness
- praise and encouragement

- recommendations for next steps

Working Group 3: Network Functions

Working Group 3 considered the software functions required in a network.

Issues

Cost control. School administrators must know costs in advance for budgeting purposes. Thus, use-based charges for telecommunications are not acceptable.

Ease of use. K-12 users will not tolerate the current software environment and will not take advantage of the potential of the network until telecommunications is easy to use. Functions must be provided in a point-and-click environment on the computers now in schools. Automatic dial-up and easy file exchange are essential.

Functionality. Text, graphics, data, and arbitrary file types must be readily transferred over the network; e-mail, bulletin boards, and databases must be easily available.

LANs. Many schools are installing Local Area Networks (LANs), so any telecomputing software should be compatible with LANs and take advantage of their potential to buffer messages between many student groups and a remote server.

Kinds of functions. There was a lively debate about the kinds of editors that should be supported. General agreement was reached on text and graphics; some kind of data analysis function also is needed. Some participants thought it unwise to attempt to supply these functions as part of telecommunications, while others felt it essential to facilitate a variety of communications.

Graphics standards. One participant argued forcefully for the adoption of the NATLPS standard, which is stable and supported by a variety of editors.

Cost. The cost of software, telecommunications, computers, and teacher training are overriding problems in most schools. Telecomputing access should be practical and low-cost through low-speed dial-up lines that are used only for file transfer at the maximum line speed.

Asynchronous. To save telecommunications charges, it may be necessary to require some or most users to work off-line in an asynchronous mode (that is, not connected to a host). The delays of non-synchronous access to databases and bulletin boards are tolerable, given concomitant cost reduction.

What Kind of Access?

Questions were raised about the best strategy to achieve broad scale use of telecomputing. There was vocal support for the idea of simply giving away as many Internet accounts as possible and letting students explore the resources available on all the interconnected computers. After much discussion, it was recognized that this is not a practical solution for large numbers of students, although it will serve the needs of a small, advanced minority. Because of the current user interface, the command line design, and the highly decentralized nature of available resources, it is difficult for most K-12 teachers and students to use the Internet effectively and to incorporate it into instructional programs.

Concern was raised about investing heavily in a single software solution to these problems. Would the software become out of date soon and thus itself become a barrier? Would the software adhere to standards, particularly integrated document standards, only now beginning to emerge? Would the software have sufficient functionality?

Recommendations

Better software is an essential *prerequisite* to the widespread use of telecomputing. This means software not just for one network or project, but rather a system design that will provide a common, powerful platform for many educational networks. Such improvements could transform telecomputing into a far more flexible medium that will support the development and easy dissemination of new educational materials and new styles of education. The design itself should be modular and based on established standards, permitting growth and allowing users to add functionality. Six design requirements were identified:

- Good user interface. All functions must be intuitive and easy to use.
- Beyond text. Graphics and data must be easily shared on the network.
- Support of commercial services. Packaged educational services must be available.
- Networks services. E-mail, structured bulletin boards, and database access are needed.
- Interconnection. Educational users should be able to communicate with each other through the Internet.
- Low cost. Telecommunications and software costs must be minimized.

For educational telecomputing to become an important force in education, each of these requirements must be fulfilled. Software to achieve these goals would represent a major improvement over present telecommunications software.

So that the software has a long, useful life, it must follow accepted standards and follow a modular design that would permit its expansion and evolution from various sources.

Survey Results

Presented below are the financial, technological, integration, and technological barriers to implementation of telecomputing, as prioritized by Conference participants. When suggested by participants, solutions are indicated as well.

Financial

Participants listed costs as the major barrier. The major cost is on-line time, and the only alternative—connecting to a high-speed backbone—is also expensive. School administrators are just beginning to learn the economics of telecommunications. At a time when financial constraints are of paramount concern, technology is viewed as an extra, a luxury. There is insufficient ongoing funding for telecomputing. Access to telephones and telephone lines also is a major problem in schools.

Suggested solutions include developing partnerships with organizations, such as local businesses, telephone companies, hardware and software manufacturers, and grass-roots organizations, who could provide low- or no-cost access. Others suggested working with state, federal, and private agencies to develop grant programs for schools to install and use the technology.

Technology

Participants frequently identified the unfriendly interfaces of most telecomputing software as a major barrier. These were described as confusing, inconsistent, cumbersome, non-intuitive, unattractive, and complex. Strong support was expressed for the development of easy-to-use interfaces, with user input in the development of these interfaces.

Also high on the list of barriers was the low speed of transmission on many electronic highways and the narrow bandwidth. Some were concerned with the lack of an international standard and support of certain protocols, making international contact using telecomputing particularly difficult. One way to overcome these barriers is to provide administrators and teachers with workshops, information, and support.

Also often mentioned were lack of technology or appropriate technology. Most schools are not equipped with the necessary hardware, software, and phone connections to access networks. There was a feeling that more examples of successful telecomputing projects and model programs would help convince the controllers of the purse strings to plan adequately for telecomputing. One participant suggested that regional consortia be developed to serve as clearinghouses for ideas, innovations, tips, and technology funding.

Teacher Support

Teacher enhancement and support in the use of the technology also was mentioned as a barrier. The suggested remedy was to provide workshops for teachers in the technology and its use as a tool for teaching and learning. Few mentioned teacher support in this context, presumably because most felt the technical barriers should be overcome by adapting the technology to the needs of educators rather than the reverse.

Teachers often cannot find time during working hours to access telecomputing resources. There should be support for home access and for technology that reduces the time and effort required for telecomputing.

Integration

A major problem for teachers and administrators is integrating good ideas and short telecomputing projects into the larger curriculum plan. There are insufficient models for classroom activities that take advantage of the potential of educational telecomputing, and a general lack of awareness that models do exist. Curriculum mandates control possible additions and limit innovations. A related problem is that teachers are not skilled in integrating telecomputing resources into the classroom.

Solutions

A variety of solutions was suggested involving a combination of information sharing and teacher support. Programs could be developed that provide incentives for outstanding curricula and hypermedia resources that use telecomputing. Again, the need for centers was mentioned for teacher support, research, and development of curriculum related to telecomputing.

Vision

Broad concern was expressed that educators do not perceive the importance of telecomputing in students' futures and that they view technology as an extra, an expendable educational resource. If the telecommunications infrastructure is to become a viable educational resource, education must be viewed as a life-long process supported by telecomputing. Educators must embrace telecomputing as a viable instructional and information-gathering tool, and they must create a nurturing environment that fosters experimentation.

Many comments indicated that a major problem is lack of leadership. The "mind shift" that has happened among many telecomputing users in research and industry, a shift that views telecomputing as a natural, regular means of communication, has not occurred because educators generally do not have access to networked computers. Hence, the larger community is unable to focus its interests and resources on telecomputing. There seems to be a lack of enterprise among educational leaders, perhaps a cultural disposition to leave things to the government. Clearly, more teachers—especially those who creatively circumvent impediments— must be provided with access to computers and networks. Educational leaders need to aggressively cultivate broad support for focused and purposeful telecomputing initiatives.

The lack of leadership is reflected in the dearth of institutions supporting educational telecomputing. There are too few advocacy groups and too little coordination among educators with similar interests. The tenacity of territorial walls between teachers and departments at the individual school level ensures that telecomputing will be resisted by those who have a strong need to control. There is a need to form an alliance of interests sufficiently committed to taking action even if the government is unable to play a key leadership role. This alliance should formulate long-range perspectives on educational telecomputing, mount a series of coordinated, well-reasoned telecomputing projects using an incremental approach, and incorporate an extensive formative feedback process in its work.

STATES AND THE CONSORTIUM

Conference participants strongly agreed with the premise that the telecomputing needs of K-12 education must be articulated. They called for educators to:

- *Establish a Consortium of institutions engaged in educational telecomputing.* This Consortium is needed to coordinate research, development, and implementation of educational telecomputing, and to bring its importance to the attention of educational policy makers and the public at large.

The process of creating the consortium is well underway. There was a follow-up meeting June 23, 1991, at the National Educational Computing Conference in Phoenix where goals, objectives, and organizational issues were discussed. The group selected the name "Consortium for School Networking" (CoSN). A Board was appointed and met in Pittsburgh on January 9-10, 1992, creating bylaws, a financial plan, and first-year goals.

Shortly before the Conference, EduCorp released a survey of state involvement in educational telecomputing. Because it provides useful background to the organizational issues addressed at the Conference, it is included as Appendix A.

Working Group 4: Organizing a Consortium

Educational telecomputing will be decentralized, and therefore there is a need for an inclusive, voluntary coordinating mechanism to share ideas, developments, and expertise. By making significant contributions for the common good, limited local funding can be greatly enhanced. A collaborating consortium can help articulate K-12 educational needs and attract funding to address those needs. It can also facilitate collaborations to solve identified problems.

Working Group 4, chaired by Connie Stout of the Texas Education Agency, was charged with developing a description of the organizational challenges of educational telecommunications, particularly at the sub-national level. It was asked to consider the following questions:

Who should be invited to join a Consortium and how should it be organized to be fair to all participants, including corporations?

Does the collaborative software development idea make sense?

Are there immediate organizational needs?

What about continuing the Conference electronically?

Might NSF funding be sought to support Consortium development? How might that best proceed?

Working Group 4 began by discussing whether or not there should be a Consortium. Emphasis was placed on the needs and benefits to states of a forum for communication, problem solving, and advocacy, to be available for preK-12 education. Any fully representative group should include members from Cleveland FreeNet, FrEdMail, FidoNet, National Education Association (NEA), International Society for Technology in Education (ISTE), special interest groups, chief state education officers, National School Board Association, National Telecomputing Industry Association, and other consortia.

The group agreed that states did need to form a consortium, with National Research and Education Network (NREN) and preK-12 participation providing a common goal and organizing focus. No clear voice representing the needs of preK-12 currently exists, and states are in the best position to fulfill that role. The group set as a priority the creation of a neutral group having no other agenda to represent. The group also acknowledged that universities could not be expected to "hand over" networks to meet preK-12 needs, and that universities required both incentives to work with preK-12 and information about the preK-12 agenda. The experiences of other consortia could be invaluable, such as the Black College Satellite Network where member colleges, working together, were able to obtain better vendor services than any individual college acting on its own.

After considerable discussion, the group defined a Consortium as a forum for preK-12, with an initial focus on the delivery of NREN services to schools. It would be largely a non-operational group, but would serve as a clearinghouse for exemplary models of education telecomputing, as the impetus and coordinating mechanism for templates and new designs for implementation, and as the initiator of staff development and training efforts.

The DRAFT mandate for the Consortium is to:

1. Make the case for a preK-12 network that is cost-effective, user-friendly, and educationally significant.
2. Make constituencies aware and educated about the advantages of telecomputing for preK-12 education.
3. Provide (or lobby for) an effective and informed preK-12 voice in NREN development, with an initial focus on public education.
4. Develop implementation plans that: (a) involve the private sector in resolving technology feasibility, access, and service delivery issues; (b) provide a voice for all preK-12 constituencies, including a key role for all states, and act as a "neutral," unified body having no competing agendas; and (c) identify and remove barriers to implementation.
5. Expedite service and product delivery by developing model ideas, advocating and supporting teacher development, and disseminating transferrable templates and designs.

The group offered to convene itself as the Steering Committee for the Consortium on a temporary basis, with Connie Stout (of the Texas Education Agency) serving as Chairperson. The Steering Committee will prepare a one- to two-page paper describing the goals and functions of the Consortium. That paper will be drafted and circulated prior to the NECC meetings to be held in Phoenix on June 17-20, 1991[7]. At the meetings, members of this Conference and others will be invited to review the paper, explore their states' interest in becoming members of a Consortium, and decide upon next steps.

Discussion ensued about establishing two committees of the Consortium, one to focus on policy and one on technical issues (the latter to include such topics as directories, user services center, connectivity packages, and standards). John Clement of EDUCOM agreed to establish two e-mail conferences, one for all Conference attendees and one for Steering Group members.

Survey Results

Presented below are Conference participants' responses to survey questions that addressed the issue of creating a Consortium of states.

The strengths of the Consortium concept include its focus on a distributed network, user-friendly interfaces, integrated tools, and its support for collaborative learning. The national leadership could foster a much needed unified program of technology and telecommunications policies, serve as an advocacy group, and provide programs of size and scope needed to impact structural reform in education. Many support the need for a Consortium to push for legislation and standards favorable to education.

However, there are weaknesses and concerns about the concept as presented. Among them are fear that the K-12 community is not yet sophisticated enough to have sufficient vision in telecomputing. Most educators have only models like FrEdMail or NGS Kids Network in their minds. The Internet may seem a jungle by comparison.

Several respondents voiced concern that the concept is too narrowly focused; that it revolves around the objective of making good user software, such as TERC's Alice, more widely available. The problems are bigger than simply developing a friendly interface to a powerful network. The consortia must respond to the systemic needs of integrating telecomputing where applicable, i.e., compatibility with other projects attempting to do the same thing at various levels, and the difficulty of coordinating "distributed curriculum building."

Challenges abound· regulations, standards, initial costs, phone connects, and logistics. One respondent mentioned the challenge of finding more than six states willing to participate to reduce the fiscal impact for development.

7 As stated previously, the meeting in Phoenix was held, and a subsequent Board meeting was held in January 1992.

Most responded positively; yes, this is feasible but more so if we were not currently in a recession-induced budget crunch. Working models, however, do exist to facilitate progress in educational telecomputing. Alberta, Canada, for example, now has five consortia dedicated to teacher training and professional development. In addition, the Satellite Educational Resources Consortium, a cooperative of 23 states, has addressed many complex issues. Another respondent stated that education must become entrepreneurial to survive.

While nearly all respondents agreed on the importance of better software, several cautioned that agreement was not reached with regard to the format which the software should take. A few supported the need for user input into the development process and others mentioned a need for more experience with TERC's Alice.

Several respondents indicated that the planned curriculum development was reasonable and that their jurisdiction could make in-kind contributions. For example, some offered to serve as beta test sites and others offered to contribute ideas and expertise. On the other hand, some felt the proposed curriculum development plan was not made clear.

RESOURCES

By the year 2000, all schools should have access to the Internet. Governmental, non-profit, and commercial providers of a wide range of educational services will be available on this decentralized network. Access will be through small computers supported by educational institutions running Unix that is accessed through direct connections, dial-up services, and LANs.

Conference participants agreed that this should happen as quickly as possible:

- *Establish connectivity with the Internet.* The Internet presently reaches all fifty states, offers extensive local connectivity, and connects the nation's post-secondary institutions, as well as much of business and industry. Connection to this network will ensure a common, low-cost pathway for educators at all levels.

Working Group 5 gazed into its crystal ball and asked the following questions: What levels of network traffic are anticipated from K-12 users? How much traffic will be at the level of the school, district, county, state (or province), region, nation, continent, between developed countries, and world-wide? Where will the local connection to the Internet reside, how much will it cost, and who will pay for it?

This section presents the results of Working Group 5, whose facilitator was Tom Dopirak of Carnegie-Mellon University. It synthesized information about the existing networks within participants' regions and the probability of connections, together with information about computer hardware and data about the current and planned availability of computers, modems, and LANs. It also examined how the interconnected network will be organized, how the network will be extended to schools, and what the organizational implications will be.

Working Group 5: Implementing Educational Telecomputing

Issue: NREN

The session began with a discussion of the National Research and Education Network (NREN). NREN is being presented to the U.S. Congress as a tool for scientists, rather than as a technology potentially having much more wide and varied purposes. K-12 is not mentioned anywhere in legislation pertaining to NREN, although a bill from Senator Edward Kennedy's committee will address K-12 use.

Working Group 5 expressed concern that the U.S. Department of Education is not involved with NREN, does not have a seat on the coordination council, and that Beverly Hunter of the National Science Foundation is the only active advocate for K-12 in Washington, D.C. Further concern was expressed about the lack of planning for regulation of NREN. In order to ensure equity of access, the Federal Communications Commission must be involved, yet at present its involvement is nil.

Recommendation

One of the first roles of the Consortium for School Networking (CoSN) should be to advocate that K-12 access be incorporated into NREN legislation.

Issue: The NSF Backbone

The current Internet consists of regional networks linked together with a backbone of high-speed lines funded by the National Science Foundation: the NSFnet. The pending expiration of the maintenance contract of the NSF backbone was addressed. The ANS, which is a non-profit, 503.c(3) corporation, will take over the support of the backbone. Its charter prohibits cross-stabilization pricing, meaning that business users cannot be charged more than non-profit and educational users. This may drive costs prohibitively high. It may be that telecomputing rates are regulated in such a way that competitive, for-profit networks may be less expensive than the non-profit ANS.

Recommendation

The Office of Technology Assessment study will/should mandate that the NSF retain control of NSFnet until regulatory authority is developed. Without regulation, the ability to connect could become increasingly political.

Issue: Network Service Needs

Network services important to K-12 education were divided into two categories: short- and medium-term.

- Short-term Needs:

1. Electronic Mail. Initially e-mail could be simple text, but eventually it should become multimedia and include graphics, and possibly sound and video.
2. Conferencing in the form of bulletin boards.
3. A directory of network services including databases, conferences, and users.
4. Databases created by K-12 users and easily accessible with the user software.
5. Access to external (and commercial) databases existing on distant servers. (The Consortium should use its group buying power to negotiate with these commercial data providers to reduce the cost to the end user.)

- Medium-term Needs:

1. Real time conferencing
2. File transfer
3. On-line help functions
4. Pass-through access to external services (e.g., the ability to log onto NEXUS) and access to library card catalogs and abstract databases.

Also discussed and agreed upon was the notion of levels of service. For example, students, teachers, and administrators might have different access to services and data. The telecomputing software must accommodate these distinctions.

Issue: Network Topology

The idealized K-12 network may be viewed as a hierarchy of networks each occupying a different level in the overall organization. The possible levels are the classroom, the school, the school district, the state, the Internet regional network, and finally the NSF backbone (and later NREN). The idealized network contains a local area network of IBM compatible PCs or Macintoshes in the classroom connected to all other classrooms via the school local area network. Each school is then connected to the school district network via a dedicated or a dial-up line. School districts are connected to statewide networks using either dedicated or dial-up connections. Finally, the state networks join the Internet via the regional networks.

Of course, the ideal arrangement is not likely to occur in very many situations. Schools may be large enough to have their own direct Internet access through a local university or through the regional network. In other instances, school districts may be so small that a dial-up connection to a county or state-wide network will be adequate. The message is that a great variety of connections and network topologies will need to be supported, including both dedicated and dial-up connections to the Internet. The need to support dial-up access requires that servers be designed to store data for later transmission.

Recommendations

1. A hierarchical naming scheme, such as that used for e-mail addresses in the Internet, was recommended. The basic form would be:

   usersname.school.school-district.state

2. Access for students and/or parents from home would likely be provided by individual schools.

Issue: Costs

The distribution of costs for the K-12 network will vary dramatically from state to state and from district to district. Technical support for the telecommunications network and for integrating it into the curriculum is most likely to occur at the school district or intermediate level (though some schools may be large enough to provide their own). Operational costs, including hardware support, also will be borne most likely by the school districts.

Recommendations

1. The cost of equipment and network wiring is likely to require outside funding for K-12 telecomputing. This may be best achieved by a consortium of groups approaching federal and state funding sources.

2. The cost to the end user should be a flat fee; that is, the same charge regardless of level of usage.

Summary

States, acting individually and as a consortium, have the following roles to play in K-12 telecomputing:

1. Providing access to the Internet either via a large state network or by providing a single network server that acts as a gateway to the Internet.
2. Assuring equitable and reasonably priced network access.
3. Advocating K-12 issues with Congress and the telecommunications industry.

Survey Results

According to Conference participants, commitment to educational telecomputing has come from such education-related sources as institutes of higher education, state departments of education, education technology offices, technology coordinators, and most notably through the efforts and creativity of computer-using teachers. In addition (and often due to the efforts of the classroom teachers), grass roots organizations, local industries and businesses, telephone companies, and software and hardware providers have also demonstrated their commitment.

Other forms of commitment exist. For example, the Connecticut Department of Education sponsors an annual competitive grant for telecommunications projects in schools and other educational technical initiatives. And the State of Washington funds educational technology centers and partnerships between K–12 schools, community colleges, and the state Department of Information Services to examine technology. In many states, telecomputing-related legislation is in the draft stage or prepared for consideration by the next legislative session.

Glossary and Guide to Abbreviations

We have attempted to keep jargon out of this report, but any project of this size, so deeply involved with technology, is bound to use some technical vocabulary. Most of these terms will be familiar to experts in the field, but we hope to reach a broad range of educators and policy makers as well as technical experts. For the convenience of the reader, we have defined some of the terminology here.

Alice. Alice, in contrast with the practice of the entire computer industry, is not an abbreviation for anything, it is just a name TERC adopted to refer to the ideas being generated about how a telecomputing system should work.

asynchronous. As used in telecomputing, refers to one-way communication between one computer and another, possibly separated in time from any response the communication might generate.

CET. The Consortium for Educational Telecomputing, the name of the TERC Conference held in April, 1991.

CoSN. The Consortium for School Networking, a new coordinating and information-sharing group of states and other institutions that grew out of the CET Conference.

educational service provider. Any operator of a host computer providing something of education value involving the use of electronic mail, structured bulletin boards, or databases.

host computer. A computer that provides access for remote users.

integrated document. A single document that consists of parts logically connected to different editors. The proposed Alice integrated document can be thought of as a long, scrolling sheet with horizontal divisions that separate the different applications, separating the sheet into text, graphics, data display, and other parts in any order.

Internet. The present collection of computers interconnected through TCP/IP protocols, including universities, the NSFnet, and the regional networks.

LAN. A local area network, an interconnected group of personal computers able to share information over high-speed data lines.

NREN. The National Research and Education Network. In this report, NREN refers to a proposed, multi-billion dollar internet network. However, the present Internet is sometimes called the "interim NREN," implying that NREN will grow from the Internet.

synchronous. As used in telecomputing, refers to the real-time communication between a user and a remote computer.

TCP/IP. One set of protocols that defines the logic of electronic message interchange, defining, for instance, how messages are broken down, sent, addressed, identified, reconstructed, and acknowledged. The Internet is based on these TCP/IP protocols.

telecomputing. A term referring to telecommunications between computers, used to distinguish from other forms of telecommunications such as video. Literally, computing at a distance.

UNIX. A large body of code, usually written in C, which provides functions of both an operating system and applications. A common operating system that supports TCP/IP protocols.

X.25. The network protocol standard, popular in Europe.

BIBLIOGRAPHY

Andrès, Y.M., Jacks, M., & Rogers, A. (1989). *Telecommunications: The educators' handbook to instructional telecomputing*. Bonita, CA: FrEdMail Foundation.

Fein, C. S., et al. (1991). *Evaluation report of National Geographic Society's Kids Network in Iowa*. North Central Regional Educational Laboratory.

Harasim, L. (Ed.) (1990). *On-line education: Perspective on a new environment*. New York: Praeger Publishers. (Contains an extensive bibliography of related research.)

Hunter, B. (1990). *Building communications-based infrastructures to support reform of science, mathematics and engineering education*. (NSF working paper) Washington, D.C.: National Science Foundation.

Hunter, B. (1991). *Linking for learning: Computer-and-communications network support for nationwide innovation in education*. Washington, D.C.: National Science Foundation.

Kurshan, B, et al. (1990). *Telecommunications in the classroom*. Eugene, OR: International Society for Technology in Education.

Laboratory of Comparative Human Cognition. *The Apple Global Education Network, 1989-90*. La Jolla, CA: University of California at San Diego.

McAnge, T. R., Jr., et al. (1990). *A Survey of educational computer networks*. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Papert, S. (1991). Introduction, in I. Harel, (Ed.), *Constructionist learning*. Cambridge, MA: Massachusetts Institute of Technology, The Media Laboratory.

Resnick, L. B. (1987). *Education and learning to think*. Washington, D.C.: National Academy Press.

Riel, M. M. and J. A. Levin. (1990). Building electronic communities: Success and failure in computer networking. *Instructional Science 19*:145-169.

Roberts, N., et al. (1990). *Integrating telecommunications into education*. Englewood Cliffs, NJ: Prentice Hall.

The Star Schools Project: Final report. (1991). Cambridge, MA: TERC.

Tinker, R. F. & Kapisovsky, P. M. (Eds.) (1992). *Prospects for educational telecomputing*. Cambridge, MA: TERC.

APPENDIX A: EDUCORP STATEWIDE SURVEY

By Bobbi Kurshan

Introduction

The past few years have witnessed a quiet but critical growth of statewide educational telecomputing networks. Now this growth has fostered a very vocal debate about the kind of networks and network access that is most feasible and most effective for K-12 education. The growth of local and state networks has been phenomenal over the past 18 months. Administrative networks are in place, are being implemented, or are planned for almost every state. In addition, more than half the states have distance education networks for instruction. These networks include the use of satellite- or computer-based technology. At this time very little integration between the two networks is occurring. Lack of communication between network developers and operators could delay the implementation of an effective high-speed network that provides inexpensive, open access for K-12 education.

Networking technology is supplementing and revitalizing education in the United States and Canada. Schools and students all over the world are "linking together" to share information and learning experiences. While this practice seems almost commonplace in many school districts and many states, it is extremely foreign in others. Some school districts are technologically rich; others grapple with the most archaic technology. However, as steps are taken to ensure greater access, the acceptance of this technology to support restructuring and curricular needs, and to achieve educational equity and meet educational goals, appears to be growing at both the grass roots and the national level.

Procedure and Analysis

Spurred by this diverse growth, EduCorp Consultants conducted a nationwide survey in 1990 requesting information on statewide networks that serve to facilitate distance learning. The survey was designed to provide data about the status of distance education networks in K-12 education and to identify the leaders in this field.

Surveys were sent to state departments of education, universities, public agencies, and private industry. The survey provides data that can be used to assess the current status of networks in education and to maintain a list of key contacts for each state and network. This survey also serves to update a similar study performed at Virginia Polytechnic University in Spring, 1990 (McAnge). The Virginia Tech study was designed to assess computer networks and networking activities in K-12 education. It documented administrative support and instructional networks that facilitated the educational environment. It did not specifically target distance learning or distance education activities as the EduCorp study does.

The overall EduCorp survey response rate was an extremely encouraging 57%. Each state was sent at least one survey. Overall, the state response rate was 82% (41 states). Of those, 32 indicated they currently have at least one statewide network for distance learning, and nearly half have more than one. For example, Hawaii has an interactive television system and a computer-based system, and Florida operates two systems (FIRN and SUNSTAR). In addition, 21 of the 41 responding states have plans to upgrade existing statewide networks or to implement new statewide distance learning networks. Upgrading in many cases will be layering atop existing network technology.

The technological attributes of the statewide distance learning networks cover a wide spectrum. Many are satellite-based with up-links and down-links and offer interactive television, 2-way audio and video, and sometimes data. The computer-based systems tend to be associated with universities or schools of higher education. Not all respondents indicated the type of technology their network employs; however, of those that did, the split was nearly even between satellite and instructional television systems, and computer-based systems. Some of the newer network plans call for fiber optic cabling. Most states did not offer anticipated completion dates for their networks; however, many did indicate that lack of funding was impeding progress.

Comparing EduCorp survey to Virginia Tech study results shows that five states that did not respond to the Virginia Tech survey now indicate they have a statewide network operating for distance learning. In addition, a few of the networks have grown from their original design and purpose of administrative support (student, staff, and financial information) to incorporate distance learning activities.

Tables A-1 and A-2 present survey results by state. The first lists the contact person and network name for those states that currently have operational statewide networks. The second lists the contact person for those states that have plans to install a statewide network. Table A-3 lists the network name, a contact, and his/her address and phone number. Every individual who responded to the survey or who was subsequently contacted by EduCorp Consultants is listed here.

Summary

As education moves through the restructuring movement of the 1990s, the growth of networks will become both the director and the benefactor of the change. Local, state, national, and international networks will provide the links for communication and change. The EduCorp survey produced information on the current status of distance education networks, but additionally it provides some insights into the progress that needs to be made, the impediments to that progress, and the potential appearance of future networks.

Progress is being made in the areas of access, design, and connectivity. More students and teachers are using network facilities and educational materials available on networks.

The impediments to network growth and development fall into two major areas: cost/financing and user interface/support. These impediments must be resolved satisfactorily before progress will continue at the pace set by the reform movement.

Almost every respondent indicated that costs were prohibiting growth and access. This problem is currently being addressed at the state level and the national level through the NREN discussions and implementation. This problem will probably be solved in the near future because technology costs seem to partially take care of themselves with time. The user interface/support problem is more difficult to resolve. The need for an easy-to-use interface and standards for communication has been identified, but the look and feel of this future tool is still being explored and developed. As this process occurs, users will certainly be addressing the need for local and regional support models.

Finally, how did the respondents describe the network of the future? It will, of course, be easy to use, cost effective, accessible to all, and educationally valuable. The future is now, and this survey provides the base from which to make decisions for the networks of tomorrow.

Table A-1

Existing Statewide Networks by State

State	Network name	Contact
AL	SDENET	Rex C. Jones
AK	UACN	Mike Cinij
AK	UACN	Cathy Carney
AZ	Arizona EdLink	John Cikalo
CA	CSUNET	Craig Blurton
CT	Knowledge Network	Betty Goyette
DE	University of Delaware	William J. Geppert
FL	SUNSTAR & FIRN	Bill Schmid
GA	GC EduNET	Frank Lowney
GA	GEIS	Les Butler
HI	Hawaii Interactive TV System	C J Baehr
HI	PLATO	Jon Nakasone
ID	Northwest Star Schools	Ken Reed
IN	Electronic School District	Michael Halla
IN	IDEANet	Mike Huffman
IN	IHETS	Mark D. Commons
IA	UNI	Bill Callahan
KY	KET	Lydia Wells Sledge
ME	MENET (MaineNet)	Blynn C. Currier
ME	Community College of Maine	Pamela MacBrayne
MA	MASSNet	Ann Von der Lippe
MA	UMASS Campus Network	Randy Sailer
MI	Michigan Comm. College Network	Connie Julius
MI	Michigan Info. Tech Network	Brian Raymond
MN	MNSAT (Satellite & Technology)	Penelope L. Dickhudt
MT	National Diffusion Network	Ron Luckenbill

Table A-1 continued

State	Network name	Contact
MT	Big Sky Telegraph	Frank Odasz
NE	NEB-SAT	Wayne Fisher
NE	SERC, NEB-SAT	Melodee Landis
NJ	Educational Technology Network	Ted Smorodin
NM	Technet/Nedcomm	Art St. George
NY	Technology Network Ties (TNT)	Denis Martin
NY		William Halligan
NY	New York Network	Greg Benson
NC	NCDLS Network	Linda K. DeGrand
NC	NC DLS Network	Elsie L. Brumback
OH	Ohio Education Computer Network	Herb Van Dyke
OH	Ohio Education Computer Network	Gene Miltko
OH	Ohio Educational Broadcasting	Blan Fuller
OK	Televised Instruction System	Robert F. Parker
OR	OR EdNet	Ray Lewis
OR	OR EdNet	James W. Sanner
PA	PENN*LINK	Ann P. Witmer
SC	SCNET	Kemble Oliver
SC	SERC-SC	Bob Reese
SD	SD Public TV & Radio Networks	Doris Spicer
TX	TEA-NET	Connie Stout
UT	EDNET & UT Net. for Instr. TV	Dale Steadman
VT	Vermont Ed-Net	Alan Kousen
VT	Vermont Interactive TV	Judith Hastings
VA	VA.PEN	Cameron Harris
VA	VA.PEN	Glen Bull
WA	STEP/Star Schools	Cheryl Lemke
WI	STS/CDN	Jody McCann

Table A-2

States Planning New Networks or Extensions to Existing Networks

State	Network name	Contact
AZ		Kathryn Kilroy
CA		Vince Madden
CA	CSUNET	Craig Blurton
CO	Colorado Learning Network	Eric Feder
DE	University of Delaware	William J. Geppert
DE		Thomas F. Brennan
HI		James Bannan
HI	PLATO	Jon Nakasone
IN	KnowledgeNet	Michael Huffman
IA	IOWA Communications Network	Dean Crocker
KS		Denise Moore
KY	KET	Lydia Wells Sledge
MI	Michigan Comm. College Network	Connie Julius
MN	MNSAT (Satellite & Technology)	Penelope L. Dickhudt
MN		Joan Wallin
NE	NEB-SAT	Wayne Fisher
NE	SERC, NEB-SAT	Melodee Landis
NH		Bob Ross
NM		Mary Jane Vinella
ND		Kathryn Pederson
OH	Ohio Education Computer Network	Gene Miltko
OH	Ohio Educational Broadcasting	Blan Fuller
SC	SCNET	Kemble Oliver
TX	TEA-NET	Connie Stout
VT	Vermont Ed-Net	Alan Kousen
WA	STEP/Star Schools	Cheryl Lemke
WV	SATNET	Bobbi Nicholson
WI		Larry Dickerson

Table A-3
Network Contact List by State

ALABAMA

Ron Wright
Alabama DOE
3317 Gordon Persons Building
Montgomery, AL 36130
(205) 242-8071

SDENET
Rex C. Jones
Alabama DOE
5327 Gordon Persons Building
Montgomery, AL 36130
(205) 242-9590

ALASKA

UACN
Mike Cinij
UAS
11120 Glacier Highway
Juneau, AK 99801
(907) 789-4570

UACN
Cathy Carney
Alaska DOE
Box F
Juneau, AK 99811-0500
(907) 465-2841

ARIZONA

Arizona EdLink
John Cikalo
EdLink
1900 W Thomas Ave
Phoenix, AZ 85015
(602) 255-5061

Kathryn Kilroy
Arizona DOE
1535 W Jefferson
Phoenix, AZ 85007
(602) 542-5024

CALIFORNIA

Vince Madden
California DOE
721 Capitol Mall
Sacramento, CA 95814
(916) 445-0775

Barbara O'Connor
Education Technology
Commission
University of CA at
Sacramento
Sacramento, CA
(916) 278-6415

Diane Rude
Economic Development,
Trade & Technology
1100 J Street, Suite 404
Sacramento, CA 95814
(916) 445-4591

CSUNET
Craig Blurton
California Technology Project
PO Box 3842
Seal Beach, CA 90740
(213) 985-9631

COLORADO

Karen Sanstead
Business/Education
Partnerships
136 State Capitol
Denver, CO 80203
(303) 866-2471

Colorado Learning Network
Eric Feder
Colorado DOE
207 Colfax Ave
Denver, CO 80203
(303) 866-6859

CONNECTICUT

Linda Naimi
Connecticut DOE
165 Capitol Ave
Hartford, CT O6106
(203) 566-4987

Sigmund Abeles
Connecticut DOE
165 Capitol Ave
Hartford, CT O6106
(203) 566-4825

Knowledge Network
Betty Goyette
165 Capitol Ave
Hartford, CT O6106
(203) 566-6660

SNET
Thomas Buckley
227 Church
New Haven, CT 06506

DELAWARE

University of Delaware
William J. Geppert
Department of Public
Instruction
Townsend Building
Dover, DE 19901
(302) 739-4888

Thomas F. Brennan
Department of Public
Instruction
Townsend Building
Dover, DE 19903
(302) 739-3721

FLORIDA

SUNSTAR & FIRN
Bill Schmid
Florida DOE
B1-14 Florida Education Center
Tallahassee, FL 32399
(904) 487-0911

David Brittain
Florida DOE
Knott Building
Tallahassee, FL 32301
(904) 488-0980

GEORGIA

GEIS
Les Butler
Georgia DOE
205 Butler Street
Atlanta, GA 30306
(404) 656-2435

GC EduNET
Frank Lowney
School of Education
Georgia College
Milledgeville, GA 31061
(912) 453-4546

HAWAII

PLATO
Jon Nakasone
Comp Center Keller Hall
University of Hawaii
Honolulu, HI 96822
(808) 956-2409

Hawaii Interactive TV System
C J Baehr
Hawaii Public TV
2350 Dole St
Honolulu, HI 96822
(808) 955-7878

James Bannan
Hawaii DOE, Distance Learning Technology
1302 Queen Emma St Rm 204
Honolulu, HI 96813
(808) 548-6990

IDAHO

Northwest Star Schools
Ken Reed
Idaho DOE
650 W State
Boise, ID 83720
(208) 334-2166

INDIANA

KnowledgeNet
Michael Huffman
Educational Information Systems
Room 229 State House
Indianapolis, IN 46204-2798
(317) 232-0808

IDEANet
Michael Huffman
Educational Information Systems
Room 229 State House
Indianapolis, IN 46204
(317) 232-0808

IHETS
Mark D. Commons
Intelenet Commission
17 W Market Street
Indianapolis, IN 46204
(317) 685-8990

Electronic School District
Michael Halla
ESD
1000 E 17th St
Bloomington, IN 47405
(812) 855-2222

IOWA

UNI
Bill Callahan
College of Education
University of Northern Iowa
Cedar Falls, IA 50614-0615
(319) 273-2719

IOWA Communications Network
Dean Crocker
Communications Division
Hoover State Office Building
Des Moines, IA 50319
(515) 242-6152

KANSAS

Denise Moore
Kansas DOE
20 E 10th St
Topeka, KS 66612
(913) 296-1230

KENTUCKY

KET
Lydia Wells Sledge
Kentucky DOE
1825 Capital Plaza Tower
Frankfort, KY 40601
(502) 564-2672

MAINE

Community College of Maine
Pamela MacBrayne
University of Maine at Augusta
University Heights
Augusta, ME O4330
(207) 622-7131

Richard Riley
Maine DOE
Mail Sta. 23, Education Building
Augusta, ME O4333
(207) 289-5815

MENET (MaineNet)
Blynn C. Currier
Maine DOE
University of Maine at Augusta
Augusta, ME 04333
(207) 621-0903

MASSACHUSETTS

MASSNet
Ann Von der Lippe
MASSNet
6 St James Avenue
Boston, MA O2120
(617) 727-9500

UMASS Campus Network
Randy Sailer
University of Massachusetts
239 Whitmore AdministrationBuilding
Amherst, MA O1003
(413) 545-1955

MICHIGAN

Michigan Community College Network
Connie Julius
Michigan Community College Association
2100 Michigan National Tower
Lansing, MI 48933
(517) 372-4350

Michigan Information Technology Network
Brian Raymond
4660 S Hagadorn
East Lansing, MI 48823
(517) 336-1321

Dan Schultz
Michigan DOE
PO Box 30008
Lansing, MI 58909

Jamey Fitzpatrick
Michigan DOE
PO Box 30008
Lansing, MI 58909
(517) 373-1806

MINNESOTA

MNSAT (Satellite & Technology)
Penelope L. Dickhudt
State Board of Vocational & Technical Education
130 Capitol Sq Building
550 Cedar
St Paul, MN 55101
(612) 296-2256

Robert Price
Control Data Corporation
8100 34th Ave S
Minneapolis, MN 55425

Joan Wallin
Minnesota DOE
660 Capitol Sq Building
550 Cedar
St Paul, MN 55101
(612) 296-1570

MISSISSIPPI

Pat Teski
102 Waterwood Drive
Brandon, MS 39042
(601) 359-3778

MONTANA

National Diffusion Network
Ron Luckenbill
Montana DOE, Public Instruction
State Capitol
Helena, MT 59620
(406) 444-2080

Big Sky Telegraph
Frank Odasz
Western Montana College
Box 11
Dillon, MT 59725
(406) 683-7338

NEBRASKA

NEB-SAT
Wayne Fisher
Nebraska DOE Technology Center
301 Centennial Mall So
Lincoln, NE 68509
(402) 471-2918

SERC, NEB-SAT
Melodee Landis
Nebraska DOE
PO Box 94987
Lincoln, NE 68509
(402) 471-2918

NEVADA

Frank South
Nevada DOE
400 W King Street
Carson City, NV 89710
(702) 687-3136

NEW HAMPSHIRE

Bob Ross
PO Box 1100
Durham, NH 03824
(603) 868-1100

NEW JERSEY

Educational Technology Network
Ted Smorodin
New Jersey DOE
225 W State Street, CN500
Trenton, NJ O8625
(609) 984-1805

NEW MEXICO

Kurt Steinhaus
New Mexico DOE
Education Building
Santa Fe, NM 87501-2786
(505) 827-3806

Technet/Nedcomm
Art St. George
CIRT
University of New Mexico
Albuquerque, NM 87131
(505) 277-8046

Mary Jane Vinella
New Mexico DOE
Education Building
Santa Fe, NM 87501-2786
(505) 827-6569

NEW YORK

Technology Network Ties (TNT)
Denis Martin
NY DOE
Room 860 EBA
Albany, NY 12234
(518) 474-2380

William Halligan
NY DOE
Public Broadcasting Program
Albany, NY 12230
(518) 474-5862

Steve Kidder
NY DOE
University of the State of NY
Albany, NY 12234
518) 486-6074

Michael S Radlick
NY State DOE
Elementary & Secondary Education Planning
Albany, NY 12234
(518) 473-9106

New York Network
Greg Benson
New York Network
AE Smith Bldg, 12th Floor
Albany, NY 12225
(518) 443-5333

NORTH CAROLINA

NCDLS Network
Linda K. DeGrand
NC Department of Public Instruction
116 W Edenton St
Raleigh, NC 27603-1712
(919) 733-3193

NCDLS Network
Elsie L. Brumback
NC Department of Public Instruction
116 W Edenton St
Raleigh, NC 27603-1712
(919) 733-3170

NORTH DAKOTA

Kathryn Pederson
Deptar ment of Public Instruction
9th Fl State Capitol 600 E Blvd
Bismark, ND 58505-0440

OHIO

Irene Bandy-Hedden
Ohio Board of Education
65 South Front St
Columbus, OH 43266-0708
(614) 466-3708

Donna Boylan
Ohio Board of Education
65 South Front St
Columbus, OH 43266-0708
(614) 466-2329

Ohio Educational Computer Network
Herb Van Dyke
Ohio DOE
180 E Engler St
Columbus, OH 43266-0552
(614) 466-7000

Ohio Educational Computer Network
Gene Miltko
Ohio DOE, Computing Services
180 E Engler
Columbus, OH 43266-0552
(614) 466-7003

Ohio Educational Broadcasting
Blan Fuller
Ohio Educational Broadcasting
2470 North Star Road
Columbus, OH 43221
(614) 644-1714

OKLAHOMA

Televised Instruction System
Robert F. Parker
Oklahoma State Regents
500 Educ Building, State Capitol
Oklahoma City, OK 73105
(405) 524-9160

OREGON

OR EdNet
Ray Lewis
Oregon ED-NET
7140 SW Macadam, Suite 260
Portland, OR 97219-3013
(503) 293-1992

OR EdNet
James W. Sanner
Oregon DOE
Salem, OR 97310
(503) 378-6405

PENNSYLVANIA

PENN*LINK
Ann P. Witmer
PA DOE
333 Market Street
Harrisburg, PA 17126-0333
(717) 787-1831

RHODE ISLAND

Kenneth R. DiPietro
RI DOE
22 Hayes Street
Providence, RI 02908
(401) 277-2821

SOUTH CAROLINA

SCNET
Kemble Oliver
University of South Carolina
Center for Computers & Writing
Columbia, SC 29208
(803) 777-5992

SERC-SC
Bob Reese
SC DOE
206 Rutledge Building
Columbia, SC 29201
(803) 734-8090

SOUTH DAKOTA

SD Public TV & Radio
Networks
Doris Spicer
SD Public Broadcasting
Box 5000
Vermillion, SD 57069
(605) 677-5861

TENNESSEE

Betty Latture
Tennessee DOE
Cordell Hull Building
Nashville, TN 37219
(615) 741-0874

TEXAS

TEA-NET
Connie Stout
Texas Education Agency
1701 N Congress Ave
Austin, TX 78701
(512) 463-9091

UTAH

EDNET & UT Network for
Instructional TV
Dale Steadman
Utah DOE
250 East 500 South
Salt Lake City, UT 84060
(801) 538-7947

Helen Lacy
101 Gardner Hall
University of Utah
Salt Lake City, UT 84112
(801) 581-5852

VERMONT

Vermont Interactive TV
Judith Hastings
VT Technical College
PO Box 500
Montpelier, VT O5061
(802) 728-3391

Vermont Ed-Net
Alan Kousen
Vermont DOE
120 State Street
Montpelier, VT 05620
(802) 828-3111

VIRGINIA

VA.PEN
Glen Bull
Curry School of Education
405 Emmett Street
Charlottesville, VA 22903-
2495
(804) 924-7471

VA.PEN
Cameron Harris
VA DOE
Information Services,
PO Box 6Q
Richmond, VA 23216
(804) 225-2757(2099)

WASHINGTON

STEP/Star Schools
Cheryl Lemke
OSPI
Old Capitol Building, FG-11
Olympia, WA 98504
(206) 586-2053

WEST VIRGINIA

Brenda Williams
WV DOE
1800 Washington St E
Charleston, WV 25305
(304) 348-2691

SATNET
Bobbi Nicholson
SATNET
PO Box 707
Institute, WV 25112
(304) 766-2070

WISCONSIN

Larry Dickerson
WI Educational
Communications Board
3319 West Beltline Highway
Madison, WI 53713
(608) 273-5501

STS/CDN
Jody McCann
Information &
Telecommunications
Management
PO Box 7844
Madison, WI 53707-7844
(608) 266-6700

CANADA

W. Leigh Hull
Alberta Educational Response
Center
6240 113th Street
Edmonton, Alberta T6H-362
CANADA
(403) 422-6326

Anton Ljutic
Champlain College
900 Riverside Drive
St Lambert, Quebec J4P-3P2
CANADA

APPENDIX B: CONFERENCE PARTICIPANTS

Sigmund Abeles
Department of Education
165 Capitol Avenue
Hartford CT 06106
203-566-4825
GTE ct.doe

Fred Achberger
Office of State Superintendent of Public Instruction
Old Capitol Building, FG-11
Olympia WA 9850
206-586-2053
AppleLink: ACHBERGER1

Steve Barbato
Department of Public Instruction
Townsend Bldg.-Lockerman and Federal Sts
Dover DE 19901
302-739-4681

Larry Barker
202-586-3880
&FEDIX, via modem, data # (301)258-0953

Ed Barry
Vermont State Technology Council
Cheery Street
Milton VT 05468
802-893-3225
AppleLink K 2237

Walter Barwick
Black College Satellite Network
500 North Capitol Street NW
Suite 801
Washington DC 20001
202-737-2405

Craig Blurton
P.O. Box 3842
4665 Lampson Avenue
Seal Beach CA 90740
213-985-9631
cblurton@atl.calstate.edu

John Bolles
508-467-2140

Donna Boylan
Ohio Board of Education
65 South Front Street
Columbus OH 43266-0708
614-466-2329
BOYLAN@ODE VAX

Monica Bradsher
National Geographic Society
17th and M Streets NW
Washington DC 20036
202-857-7089
AppleLink: BRADSHER.M ;
Prodigy: MBRADSHER ;
America Online: MONICAB5

Fred Brigham
Nathional Catholic Educational Association
1077 Thirtieth St. NW, Suite 100
Washington DC 20007
202-337-6232
Mcfanet Fred Brigham + IRIS

Glen Bull
Curry School of Education
405 Emmett Street
Charlottesville VA 22903
804-924-4617
GBull@Virginia.edu

Bob Carlitz
Department of Physics and Astronomy
University of Pittsburgh
Pittsburg PA15260
412-624-9027
RDC@VMS.CIS.PITT.EDU

Jane Caviness
NCRI Department
National Science Foundation
1800 G Street NW Room 416
Washington DC 20550
202-357-9717
jcavines@nsf.gov

6υ

John Clement
EDUCOM, Suite 600
1112 Sixteenth Street NW
Washington DC 20036
202-872-4200
jrc@bitnic.bitnet

Gordon Cook
202-228-6766
tmn!cook@uunet.uu.net

Harold Cothern
804-225-2099
hcothern@vdoe386.vak12ed.edu

Dan Daniel
Jostens
6170 Cornerstone Court E, Suite 300
San Diego CA 92121
619-587-0087
AppleLink V0759

Kenneth DiPietro
3RI Department of Elementary and Secondary Education
22 Hayes Street
Providence RI 02908
401-277-2821
RI CSSS (PsiNet)

Tom Dopirak
Library Automation & Computing Systems
Hunt Library
Carnegie Mellon University
Pittsburgh PA15213-3890
412-268-6404

Jim Ellis
Biological Sciences Curriculum Study
830 N. Tehon, Ste. 405
Colorado Springs CO 80903
719-578-1136
JELLLIS%CCNODE@COLORADO.BITNET

Eric Feder
Department of Education
201 East Colfax Avenue
Denver CO 80203
303-866-6859
MCI efeder

Miles Fidelman
873-2494
mfidelman@bbn.com

Jamie Fitzpatrick
Department of Education
608 West Allegan
Lansing MI 48933
517-373-1806

David Geiger
Bell South Advanced Networks
1100 Johnson Ferry Road NE, Suite 900
Atlanta GA 30342
404-847-2055

Steve Grimes
317-232-9050
(317)232-0982 (IDEANET)

Steve Gross
802-828-3111

Michael Halla
Electronic School District
University Computing Services
1000 East 17th St.
Bloomington IN 47405
812-855-2222
MHALLA@INSTEPS

Kim Hayden
914-644-7285

Leigh Hill
Alberta Education Response Center
6240 113 Street
Edmonton, Alberta T6H-3L2 CANADA
403-422-6326
(1-403-880-0040[ASPEN])

Mike Hoebel
British Columbia Educational Technology Center
PO Box 2625
1515 McTavish Road
Sidney BC CANADA V8L 3Y3
604-655-4846
AppleLink (cda 0556)

Dave Hughes
Old Colorado City Communications
2502 W. Colorado Avenue, Suite 203
Colorado Springs CO 80904
719-636-2040
daveh@csn.org / dave@oldcolo.uucp

Beverly Hunter
NSF
1800 G Street NW, Room 635 A
Washington DC 20550
202-357-7071
bhunter@nsf.gov

Gerald Jehling
Southwestern Bell
1010 Pine Street, Room 921
St. Louis MO 63101
314-247-6769

George Johnston
Plasma Fusion Center, MIT
NW16-236
Cambridge MA 02139
617-253-8652
gLj@nerus.pfc.mit.edu

Kathryn Kilroy
Department of Education
1535 West Jefferson
Phoenix AZ 85007
602-542-5024

Melodee Landis
Department of Education
941 O Street, Ste. 210
Lincoln NE 68508
402-471-2918
mlandis@CRCVMS.UNL.EDU

Betty Latture
Department of Education
Cordell Hull Building
Nashville TN 37219
615-741-0874

Bill Leland
IGC
18 deBoom Street
San Francisco CA 94107
415-422-0220
bleland@igc.org

Cecilia Lenk
MCET
University Park at MIT
38 Sidney Street, Ste. 300
Cambridge MA 02139-4135
617-621-0290
AppleLink X2082

Tracy Licklider
617-252-0600
TRL@WORLD.STD.COM

Dick Lookatch
Agency for Instructional Technology
1111 West 17th Street
Bloomington IN 47404
812-339-2203

Jim Luckett
NYSERNET
111 College Place
Syracuse NY 13244-4100
315-443-4120
Luckett@NYSERNET.org

Ron Lukenbill
Office of Public Instruction
Department of Education
State Capitol
Helena MT 59620
406-444-2080
Applelink: LUKENBILL1 /
RON@BIGSKY.UUCP

Claudine McGee
601-982-6565
AppleLink

Frank Odasz
Big Sky Telegraph
Western Montana College, Box 11
Dillon MT 59725
406-683-7338
franko@bigsky.UUCP

Mabel Phifer
Black College Satellite Network
500 North Capitol Street NW, Suite 801
Washington DC 20001
202-737-2405
SmartNet - MPPhifer

Michael Radlick
New York State Education Department
Office of Elementary and Secondary Education
Planning, Room 867
Albany NY 12234
518-473-9106
New Bitnet address: mradlick@TNT

Bob Reese
Office of Instructional Technology
Department of Education
206 Rutledge Building
Columbia SC 29201
803-734-8090
AppleLink (SC, GA, NC, FL, AL)

Nora Sabelli
605 E. Springfield
Champaign IL 61820
217-244-0644
msabelli@mesa.uiuc.edu

Bill Schmid
325 W. Gaines Street, Suite B1-14
Tallahassee FL 32399
904-487-0911
XNDFRN01@SERVAX

Lydia Sledge
Department of Education
1825 Capital Plaza Tower
Frankfurt KY 40601
502-564-2672
AppleLink K1395, Compuserve 75 775,1344

Chris Spelius
United States Congress
Office of Technology Assessment
600 Pennsylvania Avenue SE
Washington DC 20510
202-228-6936

Art St. George
University of New Mexico
2701 Campus Blvd, NE
Albuquerque NM 87131
505-277-8046
STGEORGE@BOOTES.UNM.EDU

Kurt Steinhaus
Department of Education
Education Building
Santa Fe NM 87501-2786
505-827-3806
Compuserve - Steinhaus

Connie Stout
Division of Educational Technology
Texas Education Agency
1701 North Congress Avenue
Austin TX 78701
512-463-9091
CStout@UTADNX

David Usher
New England Telephone
800 Hinesburg Road
South Burlington VT 05403
802-863-0695
CompuServe 76416,1671

Joan Wallin
Department of Education
660 Capitol Square
550 Cedar Street
St. Paul MN 55101
612-296-1570

Frank Watson
College of Education and Social Services
University of Vermont
Burlington VT 05405
802-656-3356
AppleLink - TADPERV F_WATSONQUVM_VA

Ron Wright
Department of Education
3317 Gordon Persons Building
50 N. Ripley Street
Montgomery AL 36130
205-242-8071

Pat Zorena
NYNEX
1113 Westchester Ave
White Plains NY 10604
914-644-7313

Appendix C: Abstracts of Papers[8]

Berenfeld, Boris. "Introducing Telecomputing to Soviet Schools."

After setting the historical context in which telecomputing was initiated in Soviet—a term the author deliberately chose to use—schools, Berenfeld shares his experience, frustrations, and successes in making global telecomputing a reality. He concludes by describing new projects underway in his native land.

Bradsher, Monica. "A Publisher's Perspective on Telecomputing."

One of the most important contributions telecomputing can make to education is through the provision of curricular material. To create high-quality curricula that will reach a wide audience requires the collaboration of developers and publishers. The National Geographic Society has undertaken three different telecomputing publishing efforts, and Bradsher draws practical lessons of broad value from each. Problems addressed include providing user support (including locating the end-user); billing and fees; equity between urban and rural schools; and software design.

Bull, Glen, Harris, Cameron, and Cothern, Harold. "Considerations Underlying the Architecture of a State Public School Telecomputing Network."

Bull and Harris present a detailed overview of Virginia's Public Education Network (PEN), an electronic telecomputing system designed to provide an infrastructure tying the public school system together and linking it with institutions of higher education. Network design issues are explored, following implementation of a prototype system, and goals established. Development guidelines are presented as the "network architecture," dictated in part by barriers to access and cost. The system chosen was the distributed computing network, which is described in detail. Network software considerations are assessed, including the choice of Unix to develop network software; the adoption of Usenet as the conferencing system; and issues underlying high-speed connections. The paper summarizes information indispensable to other states developing educational networks. A brief but valuable reference list guides the reader to further resources.

---

8 Complete papers appear in a companion volume, Prospects for Educational Telecomputing: Selected Readings (1992). Robert F. Tinker & Peggy M. Kapisovsky, eds. Cambridge, MA: TERC.

Clement, John. "Networking for K-12 Education: Bringing Everyone Together."

If educational telecomputing is to grow with a minimum of false starts, Clement argues, K-12 network practitioners and resources should be familiar with one another's successes and failures. Accordingly, Clement provides an annotated listing of existing network resources serving K-12 education, including networks, affinity groups, projects, services, and information resources. The paper presents a brief discussion of issues and obstacles, then concludes with suggestions for achieving widespread connectivity.

Foster, John. "International Telecomputing."

It may come as an unwelcome shock to those in the United States that Britain is far ahead in the application of telecomputing to education. Foster shows that educators in Britain make widespread use of telecomputing through a surprisingly low-cost, flat-rate service supplemented by a rich variety of services and materials. The rate system is described, as are services offered and the overall impact on education. Foster offers many practical suggestions worthy of note by those implementing similar systems in the United States, Canada, and elsewhere.

Gore, Senator Al. "Networking the Future."

Senator Gore demonstrates that an educational telecomputing network system in the United States should be regarded as a vital part of the country's "infrastructure." At present, however, there is a "chicken/egg" problem: since there is no master network, there is no apparent demand for its use; since there is no demand, there is no network. After making a case for a master network, Senator Gore reviews the history of his legislative effort, "The Supercomputer Network Study Act."

Hunter, Beverly, "Linking for Learning: Computer-and-Communications Network Support for Nationwide Innovation in Education."

Hunter notes that the grand challenges in educational reform require new kinds of collaboration among institutions and individuals. At the same time as new educational structures are sought, the National Research and Education Network (NREN), the telecommunications infrastructure, is being engineered and deployed. The knowledge gained from past and current projects in educational telecomputing can help build the appropriate telecommunications infrastructure for education. Hunter identifies the elements necessary to lay the foundation for productive use of computer-communications networks in education.

Julyan, Candace. "A Developer's Perspective on Telecomputing."

Organizations developing educational telecomputing curricula face a number of considerations that must be overcome to make a successful project. One of the best examples of collaboration in science education between developers and publishers is the

National Geographic Kids Network. Julyan explains the detailed curriculum, software, and scientific considerations that went into making the NGS Kids Network successful.

Leland, Bill. "IGC Networks and Education."

Leland begins with a history of the Institute for Global Communications (IGC), a computer-based communication and information sharing system whose mission is to encourage the effective use of telecommunications to work for environmental preservation and for peace. IGC hardware, software, and international connectivity are described, followed by a discussion of IGC's specific educational applications, focusing on EcoNet, which is used by students and teachers as a global environmental educational tool. The lessons learned at IGC will be valuable for others endeavoring to establish international connectivity.

Lenk , Cecilia. "The Network Science Experience: Learning from Three Major Projects"

Lenk presents the concept of "network science," whose overarching goal is to give students and teachers the opportunity to *do* science and mathematics using microcomputers and telecommunications networks. After presenting some commonalities among Network Science projects, Lenk proceeds to assess three specific examples: The National Geographic Kids Network, the TERC Star Schools Project, and Reach for the Stars. Evaluation considers software, teacher staff development and support, impact on disadvantaged students, communication with working scientists, dissemination, and other issues.

Parker, Pat. "Alice: Telecommunications for Education."

If NREN is to function effectively and within economically feasible parameters, software must be developed that simplifies access, reduces costs, and promotes the development of new educational materials and services. The challenge is to create one software system that will support interconnection through the Internet and meet the criteria above. Parker summarizes the TERC-developed "Alice" software. Six design requirements are identified and discussed. Software functionality provided by Alice will include access to the Internet; storage facility; user-request monitoring; e-mail, structured bulletin boards, and news functions; databases; gateways to existing networks; commercial services; and multiple models for user interaction with the host.

Riel, Margaret and Levin, James. "Building Electronic Communities: Success and Failure in Computer Networking."

Riel and Levin note that, although the technology to create electronic global communities currently exists, many global networks have failed. By contrasting successes and failures, real-life, practical lessons can be applied when developing or altering networks. The authors examine the characteristics of university researchers' networks, teachers' networks, and student networks in terms of group structures, task organization, response opportunities and response obligations, and evaluation/coordination factors. Using this background, they then examine two actual global networks—the InterCultural Learning Network and the AT&T Long Distance Learning Network—in context of the characteristics outlined above. From these analyses, lessons pertaining to success and failure of global networks are presented. The paper concludes with a broad-based reference list focusing on global networks.

Stout, Connie. "TENET: Texas Education Network."

In Texas, legislation has mandated the electronic linkage of all 1,050 schools—more than 3.2 million students. Stout details the requirements formulated as part of planning this large-scale system. Texas decided to develop an Internet-compatible system with the University of Texas system as the network carrier. Stout details the reasons for this selection and outlines the basic components and capabilities of TENET.

Weir, Sylvia. "Electronic Communities of Learners: Fact or Fiction."

Weir provides a concise overview of educational telecomputing networks in their various guises: networks linking schools within the United States and around the globe, teachers to teachers, students to students. Barriers and benefits of telecomputing are discussed generally, then supported with specific examples from existing projects. Two case studies are presented in detail: The Science Teachers' Network and the TERC Star Schools Project. The resulting evaluation assesses practical issues such as promoting teacher change and impact on students. Weir summarizes major issues behind innovative telecomputing efforts and points the direction to success while identifying possible pitfalls. The paper concludes with an extensive bibliography.