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ABSTRACT
        In October 1993, more than 70 educational decision
makers and practitioners from across the country met to discuss ways
to support and promote school networking and to formulate
recommendations for the National Science Foundation (NSF) to use in
establishing funding priorities, goals, and evaluation strategies.
This report presents the recommendations that came out of this
conference. Broad consensus was reached on the need for educational
change, the potential of networking to enable change, and the
critical success factors for change. Policy makers are urged to work
together to develop a careful, consistent, and coordinated strategy
to support networking. A first set of recommendations asks that
networking demonstration projects be established, with
cross-curricular content and collaborative-learning features. Other
recommendations center on the need for teacher training, planning and
management for equitable and optimal use of networking, and the
development of open, scalable, and replicable systems. A training
model is described. Appendixes list conference participants,
discussion summaries, and a bibliography of 170 references. (SLD)

Building Consensus/Building Models:
A Networking Strategy for Change

March 1994

Principal Investigators
        Laura Breeden, Executive Director, FARNET
        Eric S. Hood, President, FARNET

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1 Executive Summary

There is widespread agreement that America's public schools need modernization. In the era of the global economy, when information technology has revolutionized the way business, higher education and, increasing `y, governments communicate, schools still rely for the most part on traditional methods of teaching and learning inherited from the industrial age. Teachers, it is often remarked, are the only professionals who do not even have telephones on their desks.

On October 28 and 29, 1993, more than 70 educational decision-makers and practitioners* from across the country, and from all levels of the educational system, met near Washington, D.C. They came to discuss ways to support and promote school networking and to formulate recommendations for the National Science Foundation (NSF) to use in establishing its funding priorities, goals, and evaluation strategies.

Four weeks of on-line discussions, using the Internet and other computer networks, preceded the workshop. Participants looked at core issues in five topical areas, covering access and connectivity, content and curriculum, training and user support, finance, and reform. The on-line discussions were successful in building individual and group confidence as well as in processing many important issues.

The two-day workshop built on the success of these discussions. We reached a broad consensus on the need for educational change, the potential of networking to enable such change, and the critical success factors for any networking project, program, or plan.

We offer our advice and recommendations to the NSF in the hope that they and other funding agencies will consider them carefully. We invite them to call on us, and on our colleagues, for additional ideas, ongoing feedback, and committed partnership, as we work together to improve educational opportunities for all learners through information technology.

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* In this report, we use the term "practitioners" deliberately, to include not only classroom teachers but curriculum specialists, school librarians, district and regional staff who provide training and other services to schools, and other education professionals who are "close to the classroom."

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1.1 A Consensus View of Educational Reform

Educational reform is necessary to support the needs of an information-age economy and reflect the values of an information-age society. To succeed, reform must be system-wide. But effective change cannot be legislated from the top down. It will be local and particular, not global and general — adapted to the unique circumstances of a particular community at a specific point in time. Understanding how to translate reform goals into educational policy will require coordinated and cooperative efforts at various levels that, in all cases, include practitioners.

We envision the information-age school as locus and catalyst for active, collaborative, lifelong learning — among educators, between teacher and student, among learners of all ages and conditions regionally, nationally, and globally, within the school, and between the school and the community. For all these learners networking and other advanced technologies are commonplace tools. The educator's traditional role expands to include facilitato.; innovator, researcher, and electronic publisher. All stakeholders, including practitioners and parents, contribute to the school's site-based management and play active roles in decision-making about technology as well as instruction.

Change will be neither swift nor easy. Many educational leaders have little understanding of or experience in using and managing advanced technologies. Many practitioners are fixed in their attitudes toward using technology in the classroom. Many communities view schools as "islands" and are accustomed to playing only a limited role in the formal education process. The business community and schools too often continue to view one another as unfamiliar or unequal partners. However, the potential of networking to transform and revitalize education is a strong incentive for new ways of thinking.

1.2 The Role of Networking

Networking is a powerful communications tool with the potential to facilitate educational reform. Properly implemented and supported, networking can empower and excite students and teachers. It also captures the imagination of the community. Using networking in the classroom can encourage active learning, support innovative teaching, help relieve the professional isolation of teachers, and enable practitioners to become active researchers and learners. Network technology can also support site-based management by opening new lines of communication with outside information sources and by improving internal channels of communication among various decision-making levels.

Network-based projects can also teach young learners critical information-age skills that they will need as part of the 21st century work force: collecting, organizing, analyzing, evaluating, and communicating all types of information,

using computers and other advanced technology. As the SCANS report (Department of Labor 1992) says, "Good jobs depend on people who can put knowledge to work."

Finally, networking can effectively encourage schools to enter into new partnerships with business and the broader community by giving practitioners the power to publish. It can create new opportunities for business to provide information technology and quality information products for school environments.

1.3 A Strategy for Supporting and Promoting Networking in the School

We urge policy makers to work together to develop a careful, consistent, coordinated strategy to support and promote K–12 networking. Networking projects that focus on achieving clear educational purposes can demonstrate, and thus promote, the real benefits of networking technology as a learning tool. Optimal use of the networking technology requires a commitment to training educators and to ongoing support in the form of troubleshooting, problem resolution, and dissemination of relevant information. Promoting partnerships between schools and the community and between schools and private businesses can leverage existing networking knowledge and expertise as well as educational funds.

1.4 Specific Recommendations to the NSF

While the NSF has played a significant role in demonstrating and promoting K–12 networking, its mission is limited by Congress to the support of research and education in science and mathematics. It is not empowered to support networking for more general educational purposes, or to work outside those disciplines. Greater attention to other disciplines is, however, a prerequisite to a more widespread acceptance and use of networking in schools. Therefore, we address our recommendations both to NSF and to other agencies of government, including the Department of Education and those mission agencies with educational programs.

We recommend, first, that networking projects or programs demonstrate how networking can be used to achieve well-defined, compelling educational purposes. Such projects or programs should also promote change in the cultures of both teaching and learning. Content should be cross-curricular, multidisciplinary, multidimensional, and multicultural. Collaborative learning should be encouraged within and among schools and communities, linking people of different ages, professions, ethnic backgrounds, and socioeconomic status.

Educators will need adequate introductory training for networking technology and *ongoing* training and user support. Networks are dynamic — with changing software and resources — and a time-pressed educator will demand reliability and quick fixes for any problems. Information about network resources and technologies should be disseminated widely and proactively.

At planning and management levels, we recommend that policies seek to leverage existing expertise in network technology as well as financial resources, to promote the equitable and optimal use of networking. New partnerships with the greater community and private industry should be encouraged for funding, training, user support, and network-based curriculum development. Where possible, partnerships should also encourage the sharing of resources within and across communities of learners to achieve further economies of scale and greater opportunities for equity. Communities with diverse economies and cultures can be networked together to share resources, learn from one another, and creatively work together to solve problems.

Finally, networking systems intended for widespread deployment should be open, scalable, and replicable. Because an "open standard" is one that is publicly described and documented, any company or individual can build software or hardware based on that standard, and many players can compete in delivering the best and most cost-effective products. (On the other hand, the use of proprietary systems should be discouraged, since these often restrict future options and involve greater costs.) Ideally, schools in the same district, state, or region can replicate and scale to their own needs any pilot network that is based on open standards. The ultimate goal of a networking plan should be full Internet connectivity,** and entry-level technology choices should be adaptable to that end. With open systems, educators can take advantage of a wealth of practical experience in technology deployment from the private sector to ease the learning curve.

1.5   Training Model

Training and user support are essential components of any school network plan, program, or project. The mere purchase of equipment cannot guarantee the integration of networking into the classroom. While the many variations among schools and districts will require flexible approaches to training and user support, all plans should take certain factors into account.

** Full Internet connectivity is best defined as a dedicated connection to the Internet that supports such capabilities as the exchange of electronic mail (e-mail), the access and use of another computer system (telnet), and the access and transfer of electronic files stored in another computer (ftp).

First, technology integration depends upon how well training and user support focus on educational goals. Combining technology planning with instructional and organizational planning can define and achieve consistent objectives. This approach can also serve to educate participants in the technology planning process itself.

A second and equally important factor is management support. Managers need to provide educators with both time and incentives for adopting new technology and applying it effectively: release time, professional recognition, recognition for course work on educational technologies, and funds for attending professional meetings, symposiums, and workshops.

Further, successful training needs to be hands-on and based on relevant examples and real products made by other educators. To keep pace with evolving technology, training and user support must be ongoing. Local training and user support can contribute to the familiarity, frequency, and dependability necessary for effective, regular use of the technology. Trainers with a background in K–12 education will be better equipped to understand and to help educators solve real problems.

Technology training needs to be addressed to experienced practitioners already in the schools, potential teachers in post-secondary programs, potential education managers currently in graduate schools — and to a new generation of teachers not yet in the classroom.

Partnerships among local parents, businesses, and community institutions (such as colleges, universities, and museums) can help mobilize resources for the financial support required to integrate networking in the schools. Such partnerships can also help in providing training and user support and in assisting educators to work with students on networking projects.

Finally, in addition to operational training and support, all users will require training for the ethical and appropriate use of networks. The predominate concern is that students do not access information that can be harmful or engage in communications with adults that can be harmful. There are also concerns about violations of copyright, protection of intellectual property, and conformance with the "acceptable use" policies of networks supported by public funds.

2 Areas of Consensus: A Reform Vision Supported by Networking

2.1 Change and the Information-age School

There was b·· ıd agreement among project participants that America's current educational s· stem, which is largely based on an industrial-factory model, needs to be ı. vamped to meet the needs and expectations of a knowledge-based society. Today's students need to master critical information-age skills: finding, evaluating, and using all kinds of rapidly changing information to solve complex problems. The school system must support this new kind of learning.

What is our vision of the information-age school?

- Learning occurs in collaboration, not in isolation

- Students are active architects of their own learning experiences

- Educators' roles expand: They are facilitators, innovators, collaborators, researchers, and electronic publishers

- Advanced technologies are commonplace tools for educators and students

- Interior and exterior walls become "transparent"; that is, greater collaboration among educators and students within a school, and with others around the country and the world, is encouraged

- The community actively participates in the teaching and learning processes

- All stakeholders, including practitioners and parents, play an active role in management decisions regarding instruction and technology

Systemic change will not occur overnight. Many educational leaders are not yet prepared to lead such a massive undertaking, and many educators in the classroom will not change their routines without strong direction and incentives. Reforms will be shaped by local needs and circumstances as much as by mandates from above.

We believe that computer networking, properly implemented and supported, will facilitate desirable systemic change. It can promote new ways of teaching and learning, administrative reforms, and improved community relations. By

improving the flow of information, it can speed the processes of change and lead to more knowledgeable decision-making.

2.2 Using Networking To Facilitate System Change

Networking encourages new habits and new cultures. Rather than dismantling something old and outmoded, it can build a new and different system. Networking does not condemn or reject the past but rather reaches to the future and stimulates change:

- Learners can acquire, organize, test, and construct knowledge in exciting, innovative ways

- Teachers are less isolated, more apt to collaborate with other educators both inside and outside their schools, and more likely to change how and what they teach as a result of exposure to global information resources

- Educators are better able to make informed decisions about technology purchase, technology training and user support, and curriculum development, standardization, and assessment

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"**It is very exciting to contemplate** the revolutionary opportunities for learning, teaching, and knowledge production that become possible when we visualize broad access and truly open systems, such that many people and groups of all kinds can be producing and contributing to each others' learning. If these opportunities are to become reality, it is *most* important that educational networking projects and experiments not restrict themselves to particular institutions."

Beverly Hunter, Researcher
BBN Systems and Technologies, Education Department
Reform on-line discussion
18 October 1993

"**Our vision is that information technology** will provide teachers and students with increased access to rich sources of information, compelling questions with which to examine that information, and robust tools to assist in its analysis. Schools attempting to realize this vision should do so *not* by attempting a top-down, wholesale restructuring, but through small-scale

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projects that require a collaboration of teachers, administration, and facilitators versed in both technology and pedagogy."

Bob Matsuoka, School Technology Coordinator
Reform on-line discussion
12 October 1993

"**[We] believe that telecommunications,** especially the Internet and its future replacements, can turn our agrarian schedule, factory model education system around and drag it kicking and screaming into the 21st century."

Steve Stephenson, Teacher
Reform on-line discussion
13 October 1993

2.2.1 Building a New Culture of Learning

In the last two decades, the culture of learning has undergone significant change, and many students now have increasing opportunity to construct their own learning environments. Nonetheless, learning in many places continues to be predominately passive: Teachers use "chalk and talk" to pour "knowledge" into students' heads — particularly in urban and other public schools where the teacher is responsible for very large numbers of students, who may have different learning styles and abilities. Coupled with the general acceptance of mainstreaming, the demise of tracking further complicates the responsibilities of the classroom teacher.

In addition, the curriculum, or content of learning, is often rigidly defined. Textbooks may be reviewed and replaced at five year (or longer) intervals. Schools and school systems are under increasing pressure by various segments of society to use curriculum materials that pass their special-interest litmus tests. Parents, particularly in affluent areas, are highly critical of their children's performance on standardized achievement tests. The result can be a curriculum developed more to minimize community opposition than to provide improved opportunities for individual learning.

Typically, curriculum is not multidimensional, multidisciplinary, or multicultural. In elementary schools, there may not be the time or expertise to develop such an approach. In middle and high schools, departments often are isolated from one another, and opportunities to work together limited.

The relationship between teacher and student also remains rigidly defined: Teachers are largely expected to give knowledge and students to receive it. Many pressures and fears work against significant changes in these traditional

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roles. Perhaps the most notable pressures are the already heavy demands on an educator's time in any given day or hour.

Relationships among students remain largely competitive, with opportunities for collaboration and cooperation limited and carefully regulated. Since competition is the prevailing norm in American society, it is difficult for the schools alone to promote collaboration.

"In 1850, it took about fifty years to double the world's knowledge base. Today it takes only a little more than a year. The way we store, retrieve, and use information is vastly different in an information age. We must make a quantum leap in the conceptualization of what education means if we are to learn to use technology effectively. Peter Drucker in 1988 said that the American work force does not need 'knowers,' it needs 'learners.' That concept can change education more than it has changed in the last 300 years."

Frank Withrow, Director of Learning Technologies
Council of Chief State School Officers
Reform on-line discussion
11 October 1993

"Whenever we get something new, my student techno wizards are the first to master the technology. I let them pour over manuals (if they exist) and try to get the systems to work. Then students teach me. I'm often two years behind technology here. My students learn much faster than I do, and without their help, our lab really could not function."

Don Hyatt, High School Teacher
Support on-line discussion
7 October 1993

The good news is that the communication and information resources brought to the classroom by networked computers can excite and challenge *all* students. The student can take on all kinds of roles: explorer, world traveler, foreign correspondent, intelligence analyst, scientist, artist, musician, published author, and respected commentator. With the stroke of a child's finger, global distances are traversed effortlessly, and a world of rich information resources is at hand.

As networking students gain proficiency in collecting, organizing, analyzing, evaluating, constructing, and publishing knowledge, they become active

learners. They acquire skills and attitudes that they will need as information-age workers. As they learn to be adaptable, creative risk-takers, they prepare for lifelong learning.

Networked learning naturally tends towards a collaborative process even as it accommodates and reflects different, individual learning styles and orientations. Learners can be less isolated and have more frequent, regular, and meaningful exchanges with others of similar needs and interests — and with the "real" world. Indeed, communities of learners seem naturally to evolve and sustain themselves in the networked environment.

Finally, networking can bring new resources into remote or impoverished schools cost-effectively, by permitting the sharing of materials, information, expertise, and specialized skills. Many examples already exist: Scientists mentor students in West Virginia and Montana by electronic mail, students log on to NASA computers to obtain mission information as it is created, teachers form virtual "support groups" for themselves in which they interact with peers throughout the country, and professional development courses are taught electronically.

"**My vision for networking** is based on a simple semantic distinction. When speaking about networking, I believe the operative word should be 'connecting' and not 'delivering.' Most network managers are still focused on pouring things into people's heads as opposed to connecting them and thus truly empowering them. Thus while the semantic distinction is simple it is also profound. The replacement for schools in the future will be true learning communities. Each individual will be 'nested' into several learning communities, some close to home and some far away."

Gary Watts, Senior Director
National Center for Innovation/
National Education Association
Reform on-line discussion
13 October 1993

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> **"With full Internet access, students and teachers** will be able to download the latest images of the Earth from NASA's EOS Missions, correspond with students elsewhere who share common interests, exchange not only data but their interpretations. This is the kind of environment in which a student might discover himself or herself to be a scientist at heart, a discovery of life-changing proportions."
>
> David A. Thomas, University Professor
> *Curriculum on-line discussion*
> *6 October 1993*

2.2.2 Building a New Culture of Teaching

Although attitudes have changed considerably in the last decade, teachers in many places still stand in front of classrooms and lecture to students for a large part of the day. What they are required to teach is often carefully proscribed from the top down, with little room for deviation. K–12 teachers are not encouraged to publish, conduct research, or innovate. Technology is viewed somewhat fearfully by a majority of teachers, who for the most part had no exposure to technologies during their university preparation and have few incentives to pursue technology study either in service or as post graduates.

> **"Somehow, we must motivate** experienced teachers to reconsider both the content they deliver and the changing nature of instruction itself."
>
> David A. Thomas, University Professor
> *Curriculum on-line discussion*
> *13 October 1993*

> **"The need for students to become** comfortably skilled in dealing with information demands new roles for teachers as coaches — a major change for many."
>
> Kathleen Kentner, School Librarian
> *Reform on-line discussion*
> *11 October 1993*

> **"Networking within the school will alleviate** the isolation of individual teachers (who until now close their doors

and do their 'thing' with educating youngsters) and networking beyond the school will give us a less than provincial outlook."

Betty Dawn Hamilton, School Librarian
Reform on-line discussion
9 October 1993

The teacher who is already networking is likely to be an "early adopter" of technology, a risk-taker by nature. These teachers are often less provincial in outlook, less isolated professionally, less afraid of new challenges and new responsibilities, more bold and imaginative in curriculum, and more adaptive, flexible, creative, and excited about teaching and learning. They are professionals in the highest and most desirable sense of the word: positive about themselves, committed to keeping current on pedagogy and technology through research, eager to collaborate and cooperate with others within and outside the profession, and driven to communicate their experiences and knowledge to others.

Networking alone cannot change the profession and culture of teaching, but it *can* open new windows of opportunity. Increased and regular outside communication, greater and easier access to new information sources, and greater opportunities to publish and to participate in professional discussions can induce such change. Outside communication helps to augment a practicing teacher's knowledge of new pedagogical developments, support direct communication with university researchers and other practitioners, and increase his or her self-confidence as a teaching professional and lifelong learner.

Many teachers who had reached burn-out in their careers report finding renewed energy and excitement in networking. Some who were once technology-phobic are becoming technology mentors. Some who were once timid and wary of change are beginning to find satisfaction in exploring new frontiers of teaching and learning; and some, once isolated and hidden away in their classrooms, find the outside world exciting and collaboration a desirable way to teach and learn.

"The Internet provides teachers [and students too] with an opportunity to reach out beyond the walls to real data, professionals in many fields, activities on-line, and communication with peers."

Steve Stephenson, Middle School Teacher
Reform on-line discussion
17 October 1993

"I would like to think that many, even most, teachers want to be more involved in the dynamic disciplines they teach. Science teachers would like to do science just as an English teacher might enjoy being a critical reader and an imaginative creator with words and images."

> Michael Haney, NSF Officer
> *Reform on-line discussion*
> *15 October 1993*

"Teaching is a solitary profession. I am in the classroom all day with a short break at lunch. Time to discuss ideas with others in my area of interest is rare, and, since I am an expert in a particular field in a smallish school district, there is no one who actually understands what my concerns are or what my curriculum entails most of the time. Telecommunications has provided me with the opportunity to enter discussions with other teachers with similar concerns. Access to information allows teachers to be independent researchers and learners."

> Jan Meizel, High School Teacher
> *Reform on-line discussion*
> *14 October 1993*

"Last year, when I was involved in a state telecommunications project, a remedial reading teacher I have never met in person wrote to me after the project and said she had almost retired that year, but was so glad that she had not. Telecommunications had renewed the joy of teaching."

> Stephanie Stevenson, Elementary School Teacher
> *Reform on-line discussion*
> *11 October 1993*

2.2.3 Building a New Management System

The educational management structure in America *is* changing — much as it already has in American industry where, forced by a decline in world position during the 1980s, businesses are taking a hard look at their management assumptions. Many schools now practice site-based management; teachers across the country are increasingly invited to participate in making critical decisions.

Still, many school and district administrations remain rigid, hierarchical, closed, and compartmentalized. Too often, major decisions continue to be made at the top by superintendents and school boards, with little or no input from the teaching practitioners in the schools. Internal communications remain largely

top down, controlled by mid-level managers (principals and assistant principals). External communications are mostly restricted, and community access to schools is carefully monitored.

For the most part, decisions about technology purchase, allocation, distribution, and integration in schools and classrooms also continue to be made in a haphazard and uncoordinated manner, and rarely are practitioners consulted in the process. School boards and superintendents often ask for advice from major technology vendors that are seeking to sell their wares rather than from independent technology consultants who might provide a more objective viewpoint. Moreover, administrators are typically educators first and managers second and frequently lack the kind of vision, managerial skill, and technological understanding necessary to promote reform through the effective use of advanced technologies.

"It will take more than access or mandates to make intelligent users of networking. Most of all, it will take shifts in beliefs. Teachers will need to be allowed to make changes."

Mark Gillingham, University Professor
Reform on-line discussion
7 October 1993

"Decision-makers in too many districts *still* hold technology at arm's length. When they *do* make the decision to put in technology, training and support are almost *always* an afterthought. While there is enormous attention being paid to telecom/networking now, not much of that is really filtering down to the rank and file school district."

Al Rogers, FrEdMail Director
Support on-line discussion
5 October 1993

"The load gets heavier. I am not asked or consulted. Our committee recommendations have been ignored and yet we talk about reform and on-site decision-making. I think I would prefer to be told honestly that we are back to authoritarianism and be done with it. I believe that the need to control is too deeply ingrained in many administrators, that they really have no idea how to implement these plans beyond lip service."

Stephanie Stevenson, Elementary School Teacher
Reform on-line discussion
23 October 1993

> "How many times do faculty members miss out on key information which lies in a pile on a principal's or supervisor's desk? Teacher-to-teacher contact within and among districts through e-mail will circumvent this."
>
> Mary Ellen Verona, High School Teacher
> *Curriculum on-line discussion*
> *11 October 1993*

With its potential to improve communication among all stakeholders, networking is highly supportive of site-based management. Networking eliminates the "filtering" agents and levels that can cause bottlenecks or weaken the decision-making process. Networking can provide site-based management teams of teachers, school administrators, and community representatives with quick access to information required to make rational, effective decisions, as it supports useful discussion of issues and alternative choices.

Networking schools can directly communicate their needs and wants to superintendents and school boards, who can thus gain clearer understanding of the real needs and problems at specific sites. In turn, these decision-makers can directly communicate their policy decisions and rationale to classroom teachers and communities. Finally, school practitioners can report any problems in implementation and recommend policy adjustments.

> "The most useful feature of networking is communication. Probably one of the most frustrating features of being a part of a larger education group is not knowing what is going on. Those who know seem to assume the rest of us also know....when we don't because we haven't been told. If we ask, we sometimes feel that others think we are 'nosy' rather than concerned."
>
> Betty Dawn Hamilton, School Librarian
> *10 October 1993*
> *Reform on-line discussion*

> "Since we are in the planning stages of restructuring, we have used the Internet to gather relevant information. The speed with which information was accessed was appreciated by teachers and administrators. Site-based decision-making, part of restructuring, depends heavily upon individual empowerment

and involvement. Access to information allows teachers to be independent researchers and learners."

Jan Meizel, High School Teacher
Reform on-line discussion
14 October 1993

2.2.4 Building New Schools of Learning

The traditional "school" is a defined place in a given geographic location where teachers come to teach, and students (school-age children) come to be taught. Schools are effectively islands in a community; people outside the school are discouraged from playing any significant role. Within a school different classes, grades, and departments rarely collaborate. Administrative and budgetary constraints limit inter-school project collaborations as well as other means of outside contact such as field trips and guest lectures. The curriculum is standardized, and assessment predominately measures how well students test rather than genuine knowledge or skills. Technology is used as an instructional tool at best, more typically to reinforce skills, but rarely in an innovative manner that involves a multidisciplinary or multidimensional application. The use of communications technology is typically limited and highly regulated.

With networking technology, however, educators and students can have more contact with others both in the school and outside. They are motivated to work cooperatively with new colleagues to create new learning experiences and share useful information. By means of networking, many parents are drawn into the "formal" learning process, as are others from the community who can serve as role models and information sources.

Teachers, librarians, and media specialists become more cosmopolitan — more aware of "outside" or nontraditional opportunities for learning and of nontextbook sources of information. Their instruction becomes more interdisciplinary, multidimensional, and multicultural.

Schools become educational environments for independent learners with varying styles, and learning becomes more than satisfying grade requirements. The school becomes a place to find a lifelong love of learning and acquire the abilities to learn, adapt, and perform many tasks.

Networking changes the structure of learning by negating the importance of geography, proximity, profession, trade, school, and class. Networking creates classrooms and schools based on mutual needs and goals, bringing clusters of learners together through common interests rather than convenience.

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While the roles of learner and teacher converge to some degree, the relationships between them strengthen and become richer and more meaningful. Networking teachers encourage active learning, and by so doing empower learners. In some cases, the learner becomes the teacher of new skills; in some cases, learner and teacher work together as a learning and a publishing team.

Educators and students who network also become information and training resources to other educators and learners inside and outside their building. Networking supports the development of the "citizen-teacher" and fosters citizen learning. Networking enables and stimulates the sharing of expertise with the community of learners beyond school walls and thus can support a truly seamless education system from birth to death.

"**Anyone who has been involved** with networking in general and the Internet in particular will see exciting and immediate needs for networking in accomplishing these [reform] goals. Networking quite obviously and beautifully breaks down barriers between schools and the world. Professional support is immediate and productive through listservs and other cooperative projects; distance becomes irrelevant, and the need for input and information becomes paramount."

Kathleen Kentner, School Librarian
Reform on-line discussion
11 October 1993

"**The days of the Lone Ranger are over.** No more is the successful worker/executive/etc. a sort of masked wonder who works alone, knows all, doesn't stick around, and somehow never seemed to evolve. New model for work: Ninja Turtles. Team concept, everyone has their own strengths, learns from others, coaches others, has a mentor, shared goals, figures stand out as they go along."

Joan Fenwick, Director
AT&T Learning Network
Reform on-line discussion
21 October 1993

2.2.5 Building a New Educational Technology System

Too often, new educational technologies are expected to fit into old models of teaching. We talk of "infusing" technology into the curriculum rather than redefining curriculum and learning. Students are expected to use technology in a

carefully planned manner with expected outcomes, and are not generally allowed to "play" with the technology in a way that could produce the unpredictable. Rarely is technology viewed as a teacher's tool for professional development and conduct of work.

"My problem at my school is that technology is taught in a traditional vein — a computer lab with workbook curriculum where students use the computer to produce predictable outcomes. They do learn to operate the computer, but some say it is so h-a-r-d! I wonder if they would think it difficult if they had to use the instrument to communicate with other people?"

Betty Dawn Hamilton, Librarian
Reform on-line discussion
13 October 1993

"You know that teachers are thinking and ready for change when they no longer worry about not covering objectives and essential elements (as we call our state minimum requirements in Texas) while students are working on telecomputing projects."

Kay Abernathy, District Technology Coordinator
Support on-line discussion
22 October 1993

"My biggest concern is that most people involved in the creation of technology plans still have little grasp of the true pedagogical significance of the technologies involved or the means to use them effectively."

Bob Matsuoka, School Technology Coordinator
Reform on-line discussion
4 October 1993

Networking demands adjustment, modification, and innovation. The outcomes are less defined even when using "canned" networking curriculum such as the projects offered by commercial providers. For both teachers and students the technology is more a communications device than a passive, one-way conduit of information. This tool invites both teachers and students to go out and get information, and to go out and create collaborations. These exciting challenges

stimulate the acquisition of new skills; learning is a by-product of searching for knowledge and collaborating with many types of partners.

"One of the things telecommunications does for those of us using it extensively is provide us with a community of persons with whom we have common goals, aspirations, outlook, etc. It is not necessary to have a face to face knowledge of those with whom we engage in exchanges, but it is necessary to feel a commonalty, a mutual interest and willingness to help one another, to extend beyond self."

Leni Donlan, Technology Mentor Teacher
Reform on-line discussion
9 October 1993

2.3   Components of a Systemic Approach

The desire for change coupled with a vision of how networking can promote change will not necessarily bring about the desired result, nor will the mere deployment of networking capacity to schools and classrooms guarantee an effective and optimal use of the technology to promote reform. A strategy for implementation is required. Networking must be supported and promoted in a comprehensive manner that focuses on achieving deliberate, defined outcomes.

The following components are essential to a strategic, systemic approach by a school, state or, indeed, a nation:

- Networking projects should be innovative in content and structure, and should promote standards-based systemic reform

- Networking projects must have a demonstrable purpose that relates clearly and directly to educational goals

- Training and user support systems must be adequately funded and supported as critical components of technology deployment

- Teachers must be given time, encouragement, and incentives to become proficient users of technology

- Fairness, equity, and equality should be inherent; optimal use by *all* teachers and learners should be a dominant goal

- Plans and projects should seek to leverage existing funds, support, knowledge, and expertise

- Outside linkages or partnerships for funding, technology planning, user training and user support, and curriculum development should be sought

- Information about successful networking delivery models, training and user support systems, partnerships, and projects should be disseminated widely

- The networking systems and technology should be based on open standards and protocols, and networks should be scalable and replicable

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"I feel that it will take a combined effort from all sectors of the community — state, regional, and local. Here [in Texas] we used the strategic planning model to promote broad access for our state. Our needs were clearly articulated. Our goals were defined — communications for our educational community and access to information resources were necessary to provide an educational system which our children would need. We are existing in the 'cart before the horse' mentality. Prove that network access is valued, then it will be provided. Unfortunately, until now educators haven't had the resources to provide the access and the time to conduct the research which would show the value."

Connie Stout, Director of TENET
Access on-line discussion
17 October 1991

2.3.1   Encourage Partnerships

Traditionally, schools have existed as islands surviving on fun⁴ allocations from the top down, and almost exclusively on internal knowledge resources, people, and goods. Networking programs and projects must challenge this tradition and must explore new sources of funding, information, and expertise. Business, museums, higher education, and other community institutions can bring new perspectives and valuable experience to the school, and partnerships among these players may lead to new funding sources or improved purchasing power for all of them.

Networking allows students and teachers to share their resources efficiently with other students and teachers, with entire communities, and even with the world. Similarly, networking allows cost-effective access to rapidly growing global information sources. Ultimately, the creative synergy released through unique and varying partnerships will support a more viable educational system, and a more equitable and optimal use of information resources and tools.

"As we consider appropriate models for connecting students, teachers, and administrators, we should examine the public access community networks. I like the concept of a community-based system which allows those in a geographic region to discuss and attempt to solve community problems, as well as providing Internet connections to the world so that we can learn from each other as well."

Carol Hyatt, CapAccess Coordinator Education Center
Access on-line discussion
10 October 1993

"Nothing is free. Someone pays. Our goal, in my opinion, should be to minimize the costs to a point that widespread access is affordable on an ongoing basis. This harkens back to this mistrust between business and the K–12 community. Each seeing the other as trying to rip off the other. Business seeing the K–12 market as a cash cow, and teachers thinking all services and hardware should be free because we work with kids."

Currie Morrison, High School Teacher
Access on-line discussion
16 October 1993

"We [should] look for ways to partner educators with the private sector in a win-win manner. We need to lose some of our distaste for the concept of education as a 'business.' There are big stakes here — we can use that to the advantage of our schools and our mission here."

Joan Fenwick, Director
AT&T Learning Network
Reform on-line discussion
21 October 1993

I hope that the emphasis is placed upon cooperation rather than competition in developing and sharing information about curriculum resources. If we can offer a rich variety of topics and projects for teachers to chose from by involving many various entities, we will have a better resource."

Joe Hoover, Intermediate School Teacher
Curriculum on-line discussion
11 October 1993

2.3.2 Adopt Training and User Support as a Major Component

In business, training and user support are considered integral to the successful introduction of a new technology into the workplace. Business managers understand that inadequately trained and supported workers will perform marginally with new technology, their productivity levels will fall, and frustration levels will grow. What is so obvious to human resource managers in the business sector, however, is not so obvious to education administrators and mid-level managers: Quite typically, technology training — if it occurs — is an afterthought, and user support is unreliable and difficult to obtain.

The argument often raised is that it is far easier to fund technology acquisition and deployment than it is to fund adequate teacher training and user support. Regardless of the veracity or merits of this argument, the undeniable consequence of insufficient attention to training and user support is that the technology will not be used optimally, if it is used at all, and angry taxpayers will question what seems to be extravagant and wasteful spending. Technology must be used, and used well, to justify its purchase and especially its additional deployment. Training and ongoing user support, therefore, are crucial.

"**Consider the training time** with the teacher as the most important part of your project. Given time and hardware and encouragement, she will be able to spread the message in her area. But for it to happen, she needs to have the time, machine, and assistance to learn what to do with it."

Anne Pemberton, High School Teacher
Financial on-line discussion
14 October 1993

"**When we talk about cost,** we seem to assume that everyone will want to connect to the net, and that once they connect, administrators and teachers will automatically know what to do. In our discussions, we've focused on hardware costs, but not on the costs of teacher training, or curriculum development. If we can ballpark hardware, we're also going to have to address the costs of these critical pieces. For example, training can be very expensive in districts that are governed by union contracts. As wonderful as the net is, it will all be lost, unless we also suggest a dollar figure for developing curriculum that takes advantage of this new resource [and for training teachers to use the technology effectively]."

Mario Zinga, Curriculum Trainer, Common Knowledge
Financial on-line discussion
21 October 1993

> "At times overlooked by those of us already using this medium [networking] is the need of new users for individual attention and support that allow them to persevere and ride out the 'learning curve' and concomitant discomfort as they begin to use the unfamiliar medium. I know that no one argues with this viewpoint, but I keep returning to stating the obvious, because in practice it so often does not occur."
>
> Leni Donlan, Technology Mentor Teacher
> *Reform on-line discussion*
> *9 October 1993*

2.3.3 Focus on Innovation and Reform

A curriculum that makes the best possible use of networking must facilitate standards-based systemic change. Multidisciplinary and cross-curricular, the innovative curriculum should:

- Empower teachers and students and release their creative synergy

- Allow the broader community to engage in the development and use of resources and relationships in a variety of learning environments and community settings, and not just in schools

- Encourage the establishment of new assessment tools and related reward structures

> "A group of very excited teachers 'discovered' lesson plans on the net! These new ideas became the catalyst for some to rethink how they did things. I saw restructuring of education happening in the classroom as a result."
>
> Patsy Lanclos, Master Trainer
> *Curriculum on-line discussion*
> *7 October 1993*

> "But I think the real issue here is how we establish the right kind of environment in schools, with appropriate facilitation to perhaps really achieve a new way of helping people learn. I contend that within 10 years this could change just about all our assumptions about curriculum. If it doesn't, I think it will be due to our lack of ingenuity and lack of ability to change."
>
> Jan Poley, U.S.D.A. Extension Service
> *Curriculum on-line discussion*
> *11 October 1993*

> "My contention is that the only way to get many high school teachers to seriously reconsider their methodology is to introduce them to vital new content in their chosen disciplines that can only be delivered using new technologies, new classroom management skills, new information resources, and so on."
>
> David A. Thomas, University Professor
> *Curriculum on-line discussion*
> *13 October 1993*

> "Central to this new design would be the use of technology to craft a learning environment in which authentic learning occurs using the research and communication possibilities that telecommunication enables."
>
> Mark Nelson, Middle School Teacher
> *Support on-line discussion*
> *23 October 1993*

2.3.4 Focus on Educational Need and Purpose

Too much technology — from flash cards to video discs — has been sold to schools using over-inflated promises. Networking runs the same risk. Educators (and to a lesser extent students) need to experience for themselves the unique opportunities for learning, teaching, managing, and professional development offered by networking. When these benefits are integrated into the classroom and experienced firsthand, then individual educators and students will lead other individuals, and institutions will follow. If no direct, practical relevance is demonstrated, then the technology will not be used, and certainly not regarded as an indispensable tool. Projects must have a clear educational purpose, and programs an identifiable audience, so that networking can be fully integrated, sustained, and scaled up.

"**Busy classroom teachers are** going to have to see a need for bringing telecommunications into the classroom. They are going to benefit from knowing what others are doing, why they are doing it, and how they are doing it. Any training developed is going to have to move beyond the Oatmeal Model (We're-Doing-This-Because-They-Say-It-Is-Good-For-Us)."

> Joni Rathbun, Media Specialist
> *Support on-line discussion*
> *7 October 1993*

"**The use of actual models** and products from the Internet to show educators the Internet's value during the training [is consistent with a successful training program]. It is important for the instructor to show models/products and say, this is what students/teachers do on the Internet and by the time you leave, you will be doing this too."

> Sheldon K. Smith, Junior High Teacher
> *Support on-line discussion*
> *13 October 1993*

"**My experience has been** that once a teacher has been led into a 'project' or to a 'resource,' the use of telecommunications becomes self-serving and will be continued. I see a large part of the problem as a need for leadership and modeling in ways that will be of help to the individual. And once the teacher/person is using telecommunications, concrete, sensitive, responsive support will help the practice continue."

> Leni Donlan, Technology Mentor Teacher
> *Reform on-line discussion*
> *8 October 1993*

"**Most important, however,** whatever the technology, there must be something necessary to do, profoundly important reasons to keep up the communications."

> Inabeth Miller, Former Director of MCET
> Vice President of Affiliate Programming
> Curriculum Television Corporation
> *Reform on-line discussion*
> *18 October 1993*

"**I believe that** to approach the issue of financing from the technical or hardware end, risks forgetting the educational component and losing administrators and school board members

in the technical jargon. I say this, because the final decision to buy into this new endeavor will be made by non-users whose main concern is education. Yes, we have to sell it to this group, but we can make a stronger case if we remember that our audience is school bureaucrats, and politicians who have little or no interest in the technical descriptions."

Mario Zinga, Curriculum Trainer, Common Knowledge
Financial on-line discussion
7 October 1993

"Some people (*lots*, in fact) do not share our enthusiasm for technology and its 'obvious' educational potential. For them, networking can never be its own justification; i.e., networking in order to be networked is circular reasoning."

David Thomas, University Professor
Curriculum on-line discussion
17 October 1993

2.3.5 Disseminate Information about Networking Systems and Applications

What visionaries, change agents, and early adopters of technology often forget is that technology does not thrill the vast majority of people, who may have only a limited knowledge of its applications. Too often it is assumed that information is readily available for later adopters when, in fact, the information is limited, difficult to find and collect, and insufficiently analyzed because of the limited sample and newness of educational use and application. To avoid duplication and to minimize costs and learning curves, vital information about the new technology must be shared by all.

"We need to learn from our failures so that we will be realistic about our approaches to changing the current paradigm of communication."

Connie Stout, Director of TENET
Access on-line discussion
17 October 1993

"As I have watched our school system grapple with how to proceed. I have been struck by the difficulties of trying to plan all this with too little understanding of what is involved, and no sense of who can be trusted to give good, *objective* advice.

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Companies come forward offering 'free advice,' but they are looking to sell something, and are not objective. One of the things we could do — which would be of great benefit to school systems that have developed sufficient vision to want to move forward but have too little idea of how to do so — is to lay out the kinds of questions to ask, the kinds of options available, and the types of consultants who are available to provide advice and how to determine if they know their stuff."

Carol Hyatt, CapAccess Coordinator Education Center
10 October 1993
Access on-line discussion

"An appropriate service at the regional and/or national level would be the provision of guidelines for implementation on a variety of scales. One problem is that those who are currently providing the guidance frequently have a vested interest in the conclusion: they are selling a service. Another is that those who are in a position of power to buy may be the least well-informed about the options available."

Janet Murray, Librarian
Access on-line discussion
13 October 1993

2.3.6 Demonstrate How Funds and Resources Can Be Leveraged

Limited funds and a critical window of opportunity necessitate leveraging funds and support to ensure the sustainable, equitable distribution and the optimal use of networking capacity. Schools must adopt successful funding models and learn how to attract resources and financial backers. The educational community can no longer assume that adequate funds and support will magically appear once a legitimate need is expressed or demonstrated.

Economies of scale in telecommunications can be achieved by aggregating the buying power of the education sector and by planning cooperatively. In addition, new telecommunications regulation and increased competition may bring lower prices for schools and other non-profit institutions. Employers, who are eager to see the skills of the work force improve, can partner with schools and districts to assist with planning, implementation, and training. Finally, those who understand the potential of networking to transform education must communicate their excitement to others in the community, from parents to school boards to businesses.

"**Funding could also be** coordinated at the regional or national level to effect economy of scale."

Janet Murray, Librarian
Access on-line discussion
13 October 1993

"**I think it is a mistake** to set up networks exclusively for educators and students. This will only increase isolation, will cost more than it needs to, and will not be as likely to involve others in the community who are willing to help."

Carol Hyatt, CapAccess Coordinator Education Center
Access on-line discussion
10 October 1993

"**It is the spirit of enterprise** in the heart of a good teacher that makes a project work. That work leads to success, and money follows success. Somehow we have to be realistic in devising entry levels, but uncompromising in the plans we make. We can't afford to think small or poor."

Joyce Rudowski, Librarian
Financial on-line discussion
5 October 1993

"**A corporation can** get a 'local' phone exchange installed in a non-local geographic area to save on charges. Why can't a school be granted the same privilege? Part of a public utility's charter is to serve the public good. What more deserving public good is there than our children?"

Ken Wilcox, Middle School Teacher
Financial on-line discussion
18 October 1993

2.3.7 Use Open Networking Systems That Can Be Scaled and Replicated

Any delivery system should be one that can be sustained, extended, replicated, and scaled to a larger community of users. Our common optimal goal, assuming adequate funding and site support, is universal access to the Internet for all teachers and students. Therefore, even though there are many exemplary individual efforts to promote the use of networking in schools, some degree of standardization is desirable to optimize financial and other resources. The use of

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closed, proprietary protocols and platforms restricts growth and militates against standardization, and hence should be avoided.

An "open standard" is one that is publicly described and documented so that any company or individual can build software or hardware based on that standard. This permits many players to compete in delivering the best and most cost-effective products, and it gives buyers more and better choices.

"**Full Internet access,** and the full range of skills necessary to benefit from such access, are the optimal goals for all learners. Internet access is not a black and white issue; there are different levels of access, and benefit, that challenge many of the prevailing assumptions about cost/benefit ratio."

Frank Odasz, Director, Big Sky Telegraph
A "Costs" Model for Internet Access
disseminated to the Access on-line discussion
13 October 1993

"**Of course, I would like** full-blown interactive real-time connectivity via the Internet, but the reality is that the Internet is not freely available to the vast majority of schools"

Janet Murray, Librarian
Access on-line discussion
12 October 1993

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3 Recommendations to the NSF

The participants in this project recognized that the NSF will play a key role in demonstrating and promoting the use of networks in primary and secondary schools. The NSF has clearly recognized the importance of networking in education and, within the constraints of its existing Congressional charge and budget, is working to research and develop models for curriculum, network services, and policy choices.

The general consensus was that it would be useful if NSF could explicitly recognize the links between networking and systemic reform and could support additional research, evaluation, and dissemination related to those links. We believe that the most compelling reason for any widespread deployment of information technology is that networking can effectively promote needed changes in the system of education. The complex web of relationships among systemic change, educational outcomes, and technology use, however, is not well understood (in many cases) or well documented (in others). Moreover, the data needed for informed decision-making by educational administrators, parents, and elected officials is weak.

Additionally, it is clear that the deployment of networking technology in an isolated, uncoordinated, and disjointed manner will likely have no significant systemic impact. We urge NSF (within the constraints of its mission) and other agencies charged with planning and policy making to work together to create workable plans and models for the phased, large-scale introduction of networking.

We further recommend to NSF, other agencies at all levels of government, policy makers, professional associations, and others that they acknowledge certain success criteria as necessary to support and promote the optimal use of networking in schools, and that they incorporate these criteria into their programs. Our group reached a high degree of consensus around the criteria listed below. Successful network technology plans and programs, designed for widespread use in schools, will:

- Focus on a specific educational problem or goal and address all of the systemic elements of that problem (such as curriculum development, training, user support, dissemination, access, and evaluation)

- Be extendible, that is, be able to be expanded in scale and replicated in other schools or regions

- Include a strong, ongoing training and user support component

- Be curriculum-driven, incorporating multidisciplinary, multidimensional, and multicultural content

- Work to change the culture both of teaching and of learning

- Encourage collaboration among people of different professional roles, age groups, ethnic backgrounds, and socioeconomic status; and work to build new partnerships in teaching and learning as well as in managing, training, and funding

- Demonstrate an ability to leverage funding and other kinds of support

- Include a pro-active dissemination or marketing component

- Promote equity and equality

- Work to change the planning and management culture within education

Projects that do *not* include these components may be otherwise successful in showcasing networking technology to an isolated audience, but they are not likely to optimize financial and human resources or to demonstrate the effective use of networking as an enabling technology. Potentially, such limited projects could militate against efforts to advance a more equitable, universal, and comprehensive use of networking technology.

We also identified several important "red flags" for funding agencies. We urge NSF and others to avoid funding projects that (in addition to ignoring the criteria above):

- Show little evidence of site-based management or practitioner input

- Reinforce urban, rural, and suburban dichotomies (or similar barriers)

- Focus on a single target group (age, discipline) or a single institution (unless there is a compelling research justification to do so)

- Rely heavily or solely on traditional assessment or standardized testing as an evaluation component

- Use exclusively proprietary protocols or platforms

In summary, networking projects should be carefully selected, supported, and promoted to underscore the real benefits of networking to the education process, and to encourage a more widespread deployment of networking capacity.

"**The participants in this workshop** stated unanimously, persistently, and with rich argument, logic, and evidence, that efforts in technology or reform must be truly systemic. These experienced practitioners, researchers, and innovators will no longer settle for efforts or projects that attempt to provide or develop along any single dimension (such as equipment, software, curriculum, testing, databases, teacher development, parental involvement, business, telecommunications, libraries, health care, restructuring, children, etc.) without moving hand-in-hand with people and systems across the full spectrum of society and functions. This group is adamant about the importance of telecommunications networks as an enabler of true reform through the collaboration of people across previous barriers of institution, position, place, socioeconomic level, race, sector, whatever.

"The participants are well aware that current funding mechanisms at all levels mitigate against a systemic approach, but they are vociferous in advocating change in this status quo. They want curricula that are interdisciplinary, not narrowly focused on science or math. They want services for children that cut across. health, human services, libraries, schools, and the like. They want learning opportunities for everyone, not just for students in schools. They do not want the government to fund projects that don't contribute to overall reform and infrastructure. They want government-supported projects to be accessible through the networks, in both process and products. They want time to be full participants in change and innovation. As a former NSF staffer I was continually frustrated by this group's unwillingness to buy into the existing bureaucratic structures, constraints, and programs, and their unwillingness to formulate specific recommendations within those existing constraints and opportunities.

"Upon reflection, I realized that the group as a whole had achieved a new level of synergy and understanding, and it seemed to me that their empowerment through the networks gave this particular group a level of confidence in the possibility of true reform that is rarely seen or felt."

Beverly Hunter, Researcher
BBN Systems and Technologies, Education Department
Post-CoSN–FARNET Workshop on-line statement
1 November 1993

4 A Flexible Model for Training and User Support

All of the groups in the CoSN-FARNET Project acknowledged a clear and overwhelming need to include training and user support as part of any school networking plan, program, or project. This consensus underscored a common belief that the purchase of equipment is not a guarantee of successful integration into the classroom. In the words of the Finance discussion group, "Curriculum development costs, teacher training costs, and hardware purchases are equal pieces and must be considered simultaneously." Practitioners must be trained in the practical use of technology and supported in an ongoing, long-term manner. The many variations among schools and districts will require different approaches to training and user support. Nonetheless, certain factors should be taken into account in any plan.

4.1 Technology Integration

The compelling reason for the introduction of *any* educational technology must be that the technology will enhance teaching and learning. The focus of any training or user support program must also be to support educational goals. We recommend that technology planning be closely integrated with instructional and organizational planning, so that consistent objectives can be defined and achieved. This approach carries the added benefits of educating the participants in the planning process, building a common "database" of information, and saving scarce education dollars.

Technology, in general, and networking, in particular, have the potential to change existing habits and patterns. But it must first address specific local educational needs. Over time it may — and in fact probably will — change the system, but it cannot work in ignorance of, or in isolation from, the schools as they are today.

4.2 Management Support — Incentives and Time

Educators, like other professionals, are busy people. Managers can support the introduction and use of new technologies by providing release time, professional recognition, and in some cases financial compensation to staff who are learning how to network. Network-based activities place new requirements

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on teachers: learning how to use the computers and software, incorporating networked resources into the curriculum, guiding many independent student projects. The main work force in education requires signs from management that the adoption of new technology and its effective application are considered significant aspects of professional accountability and development.

Time is an essential factor in training and user support. Teachers typically have little free time during the school day to learn to use new technologies, and even less time to train their students. Networking brings added time demands, in that using the new technology may require curriculum development and integration into current programs of study.

4.3 Components of Successful Training and Support

Successful training is an ongoing process, and as such becomes part of user support. Because technology is constantly evolving, most users will benefit from regular, confidence-building updates.

The most successful training for educators involves direct, hands-on experience with relevant examples and real products made by others in education. Training that models the behavior and illustrates the adoption of the technology is critical to success. Incentives need to be created that will provide for these models.

User support must be reliably and consistently available. If it is not, the time-pressed educator will become frustrated and may abandon the use of the new technology.

In general, the more local the training and user support, the more effective. Familiarity and dependability are critical factors. If training is conducted in an unfamiliar setting, it will be more difficult for the educator to adapt the new technology to the local setting. If user support is too far removed from the building and if support staff are not frequent visitors, busy educators will be less likely to continue to use the new technology on a regular basis, particularly if they experience any snags that are not resolved swiftly.

Staff who train and support educators must have some K-12 background or, at least, a good knowledge of the environment. Educators respond best to people who are sensitive to the unique pressures of the profession and are able to offer assistance in solving real problems.

User manuals should be concise, plain, and clear, and should include examples that focus on the local system and practical educational uses.

The need to train experienced practitioners who are already in the schools is of major importance and will for the most part be satisfied through innovative in-

service training programs. These programs should have built-in models for follow-up and support. Educators should also be given support and recognition for course work on educational technologies and funded to attend professional meetings, symposiums, and workshops.

Post-secondary teacher training programs should also begin to develop courses on advanced technologies and applications and should work with business schools to develop courses of study geared to potential managers in education. It is perhaps most critical that networking be introduced to a new generation of teachers not yet in the classroom, which will reduce in-service training costs.

4.4   Partnerships

Networking training and user support can benefit from unique partnerships. The funds and expertise required to support and promote networking can be leveraged by working with local parents, businesses, and community institutions (such as colleges, universities, and museums). These local partners can play and are playing an invaluable role in mobilizing financial resources that schools require. They can also help in providing training and user support, and in assisting educators to work with students on networking projects.

4.5   Ethical Training

Education differs from other enterprises in that children are its main constituents. As minors, they require some special protections. In terms of technology in general, and networking specifically, this requirement places additional demands on training and user support systems. Teachers can be important role models to their students. As new technologies provide access to a vast array of information, it is incumbent upon educators to be aware of the important role they will play in the appropriate use of technology.

The predominate concern is that students do not access information that can be harmful, or engage in communications with adults that can be harmful. There are also legitimate concerns about violations of copyright and protection of intellectual property. Finally, many networks are supported in whole or in part by public funds, and these networks are governed by "acceptable use" policies designed to safeguard the public investment in them. These policies must be communicated to users (students, parents, and faculty). All users should not only be instructed in the ethical and appropriate use of networks but become role models for others.

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5 Issues Requiring Further Research

Participants in this project tended to be "holistic" thinkers, seeing problems as embedded in a larger system or context. As a result, they considered a broad range of issues as they dealt with questions about how to support networking in schools. In several areas, no consensus was reached because there was not enough time or information to process the issues fully. These issues are significant; we urge NSF and other agencies tasked with studying and implementing school networking to keep them in mind for future discussion.

These issues can be divided into four core areas:

- Appropriate technology

- Appropriate level for providing networking and internetworking support

- The economics of school networking: funding sources, financial considerations, and economic policies

- Content standardization and information-age skill and knowledge assessments

5.1 Appropriate Technology

Discussions concerning networking technology largely occurred in the Access on-line discussions. Although these discussions were informative and interesting, our information base was limited. Ultimately, there was inadequate time, during the on-line exchange and later during the two-day workshop, to address these very specific concerns. Two major issues remain unresolved:

- Appropriate entry-level networking technology

- Standardization of interfaces

5.1.1 The Appropriate Level of Entry Connectivity

We agreed that the optimal level of connectivity is a full Internet connection. The functions that a full Internet connection provides are desirable for any educational environment, and the economies of scale realized through such connections cannot be achieved using other levels of connectivity.

However, opinions diverge regarding the opportunity for full Internet connection across the country and the economics of full connection. Some believe that limited funding will preclude universal, full Internet connection, particularly in rural schools. They believe that less expensive alternative systems should be promoted for use in rural regions or other areas where resources are limited and full Internet connection is not affordable.

Others, however, maintain that rural areas would benefit the most economically from the capabilities of full Internet connection. For example, higher-end connectivity would support the more equitable sharing of resources — both people and information sources — in projects that use multimedia and video. They argue that "economics" should be used to leverage the resources and seek the partnerships that will help achieve higher-end connectivity sooner rather than later.

Appropriate technology was also considered in terms of user training and support. There was some discussion that dial-up access or BBS systems are easier to use and to maintain than full Internet connections; for these reasons these means of access are desirable for entry level users. The counter argument suggested that the high-end connectivity technology is rapidly changing and becoming easier both to use and to maintain. Moreover, some argue that as the user base grows, business has greater incentive to create user-friendly interfaces.

These issues require additional information on technology development trends, networking economics, and problems of supporting users and maintaining technology in the educational system at all levels (school, district, and state).

"**For individuals and communities** without the option for full Internet access, [Internet messages stored on a local community bulletin board system for nightly transfer via high speed modems] represents a very acceptable temporary alternative. Versus the only other choice...access to nothing whatsoever."

Frank Odasz, Director, Big Sky Telegraph
A "Costs" Model for Internet Access
disseminated to the Access on-line discussion
13 October 1993

"**When I was in Alabama** in mid-September, I visited (and gave a small grant to) one school that is in one of the poorest counties of the state. I'd like to get ideas from this group about what makes sense for school like this. What 'seems' to make

sense for them right now is training in the use of an off-line reader, so that they can take part in Internet (e-mail) discussions and projects with other schools 'without spending much time on-line.'"

> Bill Wright, Director, BreadNet
> *Financial on-line discussion*
> *14 October 1993*

"I feel that the limitations of using dial-up Internet access, even SLIP/PPP, are too great for it to be the preferred solution. I do feel strongly that direct access to the Internet has a great deal of educational potential, and some of the most interesting new applications coming out (such as Mosaic and CU-See-Me) require direct access at reasonable speeds."

> Bob Matsuoka, School Technology Coordinator
> *Access on-line discussion*
> *13 October 1993*

"Support is a major issue and lack of experience with the platforms that are usually needed for Internet connectivity. Secondly, we use a VAX/VMS system that we cannot afford to replace but which creates problems with mail connectivity as we create LANs in the building. Our approach is going to have to be incremental starting with some dial-up and some low bandwidth routing to some schools that have LAN activity or phone lines to individual rooms."

> Currie Morrison, High School Teacher
> *Access on-line discussions*
> *16 October 1993*

5.1.2 Standardization of Interfaces

All agree that interfaces must be easier and more transparent before the majority of teachers and students will be able to take advantage of a full Internet connection or, for that matter, even limited connectivity. There is, however, considerable debate regarding the need for a universal, common interface for the education community. Some of the ongoing efforts to develop common interfaces were discussed as well as some of the more common mail handlers now in use, but no consensus was reached favoring one over the other. Most participants would agree that ultimately there is probably a need for a limited range of choices.

"**The idea of a common interface** is something we are developing in the State of Washington. The current thoughts of education point to local empowerment. To require a common interface that is not cost-effective (meaning almost free) is likely IMHO, a waste of time. On the other hand, NSF support that funds a national group whose sole existence is to develop interfaces that are freely available at little or no cost to districts may make some sense. Certainly most of what I see as good on the net has been developed on college campuses, and why not fund these and encourage this development with the thought in mind of using those interfaces as a set of standards at the national level."

Currie Morrison, High School Teacher
Access on-line discussion
13 October 1993

5.2   Appropriate Level for Providing Support

There was much discussion in the Access group about the appropriate level for providing technical support for networking and internetworking. The Reform and the Training and User Support groups also considered an optimal administrative support level from their perspectives. No strong consensus emerged favoring one administrative level over another in any of the areas of consideration.

Part of the difficulty stemmed from the fact that examples are limited, and among those, degrees of success at all levels vary. Successful school-based projects, district-based projects, and statewide efforts can be readily found. Likely, the future landscape will continue to be varied, and no one administrative level will be promoted as a national or universal model.

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"**In Oregon, there have been** three statewide initiatives to provide Internet access to the K–12 community. It's hard for me (as an outsider) to understand how and why so many people have been so intensely involved in constructing (and obtaining funding for) proposals for statewide networking without any apparent cross fertilization and sharing of plans among them. Each of these projects has involved dedicated efforts by one or more individuals, but little consistent planning and direction from the State."

> Janet Murray, Librarian,
> *Access on-line discussion*
> *1 October 1993*

5.3 The Economics of School Networking: Funding Sources, Financial Considerations, and Economic Policies

The most difficult discussions were those concerning the economics of school networking that occurred in the Financial on-line discussion and continued in the Thursday sessions of the workshop in the Financial group. Clearly needed is more extensive research on the costs and benefits of networking in education, in general, as well as specific research on the unique costs and benefits of networking for rural areas and other special segments of society. In addition, we need to consider the relationship between the education sector and national economic growth and to analyze regulatory and tax policies in regard to the education system. For example, telephone rate charges to schools across the nation often have a negative impact on networking, but tax incentives for businesses to give or lease equipment to schools may have a positive impact.

5.3.1 Inadequate and Incomplete Statistics

Clearly, statistical economic data concerning school networking is insufficient. Although some statistics are available, they are scattered and inadequate for rigorous economic or financial consideration. Consequently, there is a need to begin to collect critical data on the operational costs of school networking systems at varied levels, in different regions, and on different platforms, hardware, and connectivity options. This raw costing data should be collected and made available to schools, districts, states, and other countries that are now planning for school networking.

There is a similar need to analyze significant patterns and trends in cost, to quantify benefits, and to begin to project future costs of technology,

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connectivity, and LAN and WAN networking in specific regard to education. Potential economies and/or diseconomies of scale should be ascertained so that optimal levels of planning, funding, and implementing school networking can be recommended.

"The costs of Internet access will vary greatly not only from one NSF regional provider to another, but also between the variety of commercial providers beginning to make services available at a variety of levels in many areas of the country."

Don Holznagel, Technical Director
Northwest Regional Educational Laboratory
Financial on-line discussion
21 October 1993

"There was concern that the benefits side of the coin does need to be quantified to provide the statistics that could persuade administrators and school boards to jump on the bandwagon and get their schools connected to the Internet in a timely manner."

Sharon Ingram, Middle School Teacher
Financial on-line discussion summary

5.3.2 The Uncertain and Dynamic Nature of the Funding Landscape

Funding was assigned a critical importance; there was, however, no real consensus on the appropriate funding levels for the various aspects of a networking program (connectivity, hardware upgrades, platform development, training and user support, and network based curriculum development). The desirability and level of commercial involvement was debated: Some educators continue to be wary of the private sector while others are more eager to encourage partnerships between schools and local businesses that will benefit both economically.

Also discussed were regulatory changes that might help support and promote networking. Telephone rate charges for schools were frequently raised as requiring adjustment because of their current negative impact on school networking. Specifically, some suggested regulatory changes that give schools either preferential price treatment or, indeed, the same rate consideration that businesses receive for dedicated lines. Diverting some other educational funds into networking, such as Chapter I and Chapter II funds, was also discussed.

"**Perhaps state governments** and regulatory agencies could persuade the telecos to provide the needed dial-up, or leased 56K lines at substantially reduced costs to educational institutions. This would help with the ongoing costs of maintaining the connection."

> Ken Wilcox, Middle School Teacher
> *Financial on-line discussions*
> *12 October 1993*

"**It may be possible to persuade** some access providers to waive or reduce affiliation fees for the first year, to help offset the first year hardware costs."

> Ken Wilcox, Middle School Teacher
> *Financial on-line discussions*
> *12 October 1993*

"**Several sources of funding** [for Internet access] have been suggested in our state [Nebraska]. These include Chapter II funds, economic development funds from the cities, and block grant funds. The Telephone Association in Nebraska has set up a special rate for the leased lines. That is why they are relatively inexpensive — if $155 a month is inexpensive!"

> Sharon Ingram, Middle School Teacher
> *Financial on-line discussion*
> *12 October 1993*

"**There is money available** within many school budgets if we can just reorder priorities."

> Ken Wilcox, Middle School Teacher
> *Financial on-line discussions*
> *18 October 1993*

5.3.3 Economic Choice: Equity and Equality

In principle, equity and equality were endorsed as strategic goals. Differences, however, emerged concerning specific considerations and policy. It was recognized that there are unique costs and benefits associated with rural school networking development. It was also recognized that there are unique costs associated with providing networking to disabled children. Various options were suggested to help address these unique problems, and ensure that all learners and teachers be given equal opportunities to enjoy networking.

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Further studies are required to identify how to support and promote school networking in a fair and equitable manner. Should rural schools begin with limited access and then at a future time move to full Internet capability, or should they be supported in their efforts to achieve full connectivity now so as to maximize benefits quickly? At this stage in the development of school networks, will a blanket policy of priority funding to rural areas over suburban or urban areas result in leveraging of funds sufficiently and in encouraging virtual community partnerships? What kinds of regulatory changes are required for specific areas and segments of the school networking community?

These questions are significant, and the need for their consideration is urgent. While there is little information, however, there is a clear need for more advanced research into the economic and social benefits of school networking as well as innovative thinking about how funds and resources can best be mobilized to support equitable distribution and usage of networking capability.

"We need to keep in mind, however, that not all schools are financially able to even put computers in their schools let alone network them...I realize that many schools have been successful in getting grants to fund their networking efforts, but are there enough grants 'out there somewhere' to network all the schools? How will small, one-room, rural schools be able to compete with larger, cosmopolitan schools for the few grants that are available?"

Sharon Ingram, Middle School Teacher
Financial on-line discussion
21 October 1993

"In widespread, sparsely populated areas, the economic justifications are self-explanatory. I wish there were studies to support the statement; and I know of none, simply because there aren't enough networks in existence yet."

Betty Dawn Hamilton, Librarian
Curriculum on-line discussion
8 October 1993

"**Our economic justifications** will come from businesses, policy makers, planners, and community leaders who know that they will not need to retrain their employees. Graduates will come to them with skills of communications, computing and calculating — not to mention cooperating, collaborating, and connecting."

Joyce Perkins, High School Teacher/
College Instructor
Curriculum on-line discussion
18 October 1993

5.4 Standardization and Assessment of Network-based Curriculum

New network-based curriculum will require some quality control, some degree of standardization, and some new assessment tools. The medium is so new, however, that there is not yet agreement on what constitutes a "good" network-based curriculum. Certainly many excellent networking projects were cited, but the sample remains limited.

Some suggest that without standardization, and without some tools of assessment, public and administrative resistance to a more widespread application is likely. On the other hand, some suggest it is premature to develop standards and assessment tools, and their adoption at this point could retard the development of new curriculum rather than encourage it.

Clearly, the challenge is to promote an open system that encourages the innovative use of networking yet works toward some clear educational purpose that can be measured. Further dialogue and research on the impact of networking on learners and teachers should help to direct curriculum development, standardization, and assessment.

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Appendix II:
CoSN-FARNET Project
On-line Discussion Summaries

1   Summary of Access On-line Discussion

— by Currie Morrison, Group Co-Facilitator

This discussion comprised a good deal of activity with about 15 contributors and a total of about 110 messages.

We have gathered info on access models; organization of support; service responsibilities; difference in needs between rural, urban, suburban areas; and broad access models.

A. Access Models (examples from the on-line discussion)

- **Glenview School District.** Called a "Community Model" by John Mundt.

- **California On-line Resources for Educators-CORE.** The access ports are at each California state university.

- **WEdNet (Washington Educational Network).** An arm of a state supported agency that provides students information to smaller school districts.

- **Issaquah School district Washington State.** This district has used students to build the network.

- **Oregon-K12Net.** Provides a "low tech" alternative which is available — right now — on 35 bulletin board systems throughout the state.

- **PBS Learning Link.** A distributed K–12 oriented network. Servers are set up at public television agencies or, in some cases, at state departments of education.

- **Rhode Island.** This state is working at linking several state agencies, military institutions communications companies, and information providers into a consortium.

- **SENDIT.** A telecommunications network for North Dakota educators and students in the K–12 environment. It is funded by the Educational Telecommunications Council

B. Organization of Support Levels

- Local — E-mail accounts

- Local — Dial-up access

- Regional — E-mail

- Regional — DNS

- National — info highway

C. Training at all levels

D. The needs of urban, rural, and suburban areas differ in their relative proximity to an Internet pipeline and/or the lack of district infrastructure. So we heard more about dial-up and SLIP type of setups for rural districts and other districts that lacked extensive infrastructure.

E. Broad access solutions were addressed in a discussion of low cost user devices which could maximize the level of user devices throughout the country. There was a suggestion that NSF fund research in this area.

Secondly, inexpensive access in the homes and libraries as well as schools is seen as part of the overall goal of broadening access. School networks must ultimately be part of larger community networks.

Thirdly, the training of students, teachers, and community is seen as an integral part of the process.

Lastly, it is recognized that dial-up access is only a interim solution to access, given the goal of providing access to all students, teachers and administrators in each school.

2 Summary of Content/Curriculum On-line Discussion (1)

— by Patsy Lanclos, Group Co-Facilitator

After reading the many comments from our discussion group during the past 10 days, the following observations have been made:

Probable Consensus

- Many projects, which can be integrated into the curriculum, are currently available on the Internet. These projects work best when selected to fit into and support the existing curriculum.

- Interest in technology has increased due to participation in network projects.

- The more contacts one has with the "outside world", the more reason to use the network to stay in touch.

Barriers

- Time to learn, time to explore, time to try new things

- Projects with timelines and expiration dates

- Absence of user-friendly interface

- Lack of directories/guides to materials on the network

- Curriculum which begins instruction on the past and never gets to the present

- Lack of educational environment which facilitates active learning with people taking charge of their own learning

- Lack of leadership (national, state, district)

- Competition rather than cooperation in the development and sharing of resources

- Lack of access

Need More Information or Clearer Information

- How can the network open new curricular possibilities?

- How can networks help learners?

- What is working? What is not?

- What groups can help integrate existing resources especially beyond state boundaries?

- How can NSF and other government organizations leverage their resources, their current projects, and their prior experiences so that the process can be enhanced?

3 Summary of Content/Curriculum On-line Discussion (II)

— by Patsy Lanclos, Group Co-Facilitator

The curriculum group has been very active and lively. Most people have been very enthusiastic in the use of the network to enhance, excite, and motivate students as they are prepared for the variety of skills necessary in the 21st century. Two snippets follow.

Snippet One — Steve Stephenson on learning socialization skills:

- "Digital communication
    - creates a playing field with advantage to those who are creative, thoughtful, and skilled at intellectual pursuits. I believe that to be a better playground than one dominated by age and size only."
    - enables "instant" access of information and communication — negates snail-mail/interoffice lag

- How do we get there from here?
    - excite/involve students to develop authentic
    - research projects and gather data on-line
    - access satellite/image files for use in classroom
    - download software which will be useful in the classroom
    - distance education, including college, homebound
    - mentor schools and people through networking

- How can third parties support this initiative?
    - curriculum products developed under NSF funding should be available via ftp (Looking forward to Eisenhower Clearinghouse in 1994 and the Internic!)
    - distance learning courses available on the net

- Why spend the money?
    - time is money; technology saves time and enables quality
    - equal educational opportunities even with one modem

- Considerations:
    - lack of visual communication may handicap some of the communication process
    - however, this may indeed force good written communication

- however, "one's color, body shape, or disabilities are not shown"

• The payoff:

- life long learning
- graduates with skills of communicating, computing, calculating, cooperating, collaborating, and connecting
- breeding ground for development of skills identified in SCANS report and other "skills needed for success."
- "telecommunications — the critical tool in research promoting global perspective and reaching beyond the four walls of the classroom"

Snippet Two — Dave Thomas summarized what a curriculum that made the best possible use of networks would look like, using the content of mathematics:

• "Create and sustain a worldwide community of thought about the nature and value of mathematics in the modern world and the kinds of roles that mathematicians play in the world's many cultures and economies.

• "Offer students and teachers of mathematics a smorgasbord of information resources, computer software for modeling ideas and analyzing data, access to expertise (mentors), and a 'place at the table' where one's own ideas and finding may be expressed.

• "Promote and support collaborative activities involving students, teachers, researchers, and governmental and educational leaders from different cities, states, and nations.

• "Use technologies that are easy to learn and easy to use.

• "Avoid technologies that will quickly become obsolete or which cannot be upgraded.

4 Summary of Content/Curriculum On-line Discussion (III)

— by Kathy Rutkowski

The Curriculum group considered how curriculum should be defined in the context of networking. Significant agreements were reached. The group continued by discussing how best to integrate networking technology into the classroom and/or school context, including discussions about barriers to integration and pre-conditions. The group spent some time discussing how integration could be supported at higher levels and suggested a clearinghouse of projects and networked-based curriculum and recommended the utility of the SCANS report.

Here is my summation of some of the more salient points of their discussion.

How To Define Curriculum in the Context of Networking

It was generally agreed that:

- Networking can support or enhance existing curriculum

- Global networking can create new curriculum

- Networking curriculum in itself is difficult to develop because of the changing nature of the technology

- Networking skills are better taught in the context of a broader learning experience

How Best To Integrate Networking Technology into a School or Classroom

Gradual Approach

"One small keystroke for any given teacher, and one big leap for a school."

Several participants made the case that change comes slowly but then swiftly. One teacher using the networks can usually entice yet another and yet another and possibly a principal and then even a community.

The Invisible Communications Tool

Integration will occur most successfully when:

1. The interfaces are easy.

2. Skill acquisition is tied to application in a broader context.

3. There is time allocated for project development and implementation.

4. Accessibility is established — it helps to have computers in the classroom.

What Are the Barriers to Successful Integration?

1. **Time.** Classroom teachers are limited in their time that can be devoted to developing new or using canned network-based projects, training themselves and their students in the networking, and in working with the remote teachers and students.

2. **Motivation.** Teachers must be motivated to change HOW they teach as much as WHAT they teach.

3. **In-service Training Techniques.** The focus on training should be on the value and application of networking from the perspective of the specific teacher or class of teacher, such as biology teachers, grade 4 teachers, pre-school teachers, etc. Generalized training was generally recognized as not effective for most teachers.

4. **Arbitrary Time Schedules.** Canned commercial or non-profit networking projects operate on arbitrary time schedules that often do not fit into existing curriculum. These packages are not flexible and instead of neatly fitting into curriculum are often retrofitted. New projects also often involve some arbitrary times in order to comply with the individual time demands of a given class, school, academic calendar, testing periods, etc.

5. **Planning and Coordination.** Networking projects whether canned by a commercial or non-profit provider, or created by teachers and students on their own involve NEW DEMANDS on teacher and class time. These demands must be scheduled in or around other competing demands.

6. **Unfriendly Network Interfaces.**

7. **A Need for Guides and Directories.** There is a need for guides to information resources as well as guides to use of the technology that are written with the end user in mind.

8. **Student Access.** Students can become teachers of other students but to do so require access to networking technology and of course time to network

How Does Networking Support More Effective Curriculum and/or Open New Curriculum Possibilities?

Access to New Information and Knowledge Resources

Networking opens new windows to the world and to the world's vast information resources including,

1. University and government databases

2. Computational centers in universities and in government

3. People including experts and those living or experiencing life in a foreign cultural or environment

4. Remote library indices

5. Research papers, books, works-in-progress

6. New software to support new areas of learning — modeling, multimedia, etc.

7. Remote geographic places via people observers or remote-sensing device data

Access to New Ideas and Ways of Teaching

1. Access to other teachers and schools

2. Exposure to ways curriculum is being used in other places

3. Exposure to other alternative curriculum

4. Exposure to new theories and research into education, child development, child psychology, etc.

How Can Integration Be Supported Externally

1. Dissemination of successful case studies

2. SCANS Report

3. Clearinghouses for curriculum materials including those developed under Federal support. The Eisenhower Clearinghouse was cited in this regard.

4. Guides and Directories to electronic-based information resources that are up to date

5 Summary of Financial On-line Discussion (I)

— by Kathy Rutkowski

The Finance group began with some specific costing models. The group quickly reached agreement that it would be impossible to offer any ONE costing or access model. Joyce Rudowski suggested an analysis based on several phases of networking development. Sharon Ingram suggested the following tiers which were agreed upon.

Three-Tier Approach to Costing Networking and Access

TIER 1: Local area network to include a school and/or school district.

TIER 2: Dial-in access to Internet through multiple modems or networked modems.

TIER 3: Full Internet node

Marketing/Dissemination

Mario Zinga then suggested that perhaps there was too much attention to the issue of financing the technical and hardware end of networking and not enough attention to the educational benefits. Consensus was reached that the "marketing" networking to Boards of Education, etc. should be considered. Don Ely suggested to change marketing to dissemination or diffusion. Laura Breeden suggested the group consider discernible financial benefits and economic arguments for educational reform.

Cost/Benefit Analysis

The following represent a rough cost/benefit analysis based on the financial discussions.

Costs

- Buying and networking computers.
- Converting existing networks to TCP/IP compatible.
- Access charges
- Teacher Training and Support

- Telephone phone line and leased line rates

Benefits

- Benefits to Students

- Access to Information

- Equity

- Restructuring

- Intangibles — student enthusiasm, teacher enthusiasm, etc.
- Student Performance
- Impact on System Efficiency

Case Studies — Costing Examples

Ken Wilcox provided these figures for connecting a K–12 district to the Internet in Michigan via Merit/MichNet. One-time costs for connecting an existing network directly are:

Router — the first class kind that don't break	$5
Installation of the above	$400
Teleco installation (56k line)	$950
Total one-time costs	$6,350
Annual affiliate fees and line lease (varies)	about $7,000
Total for the first year	about $13,350

Then about $7,000/year thereafter.

These figures do not include the cost of networking within a district.

Sharon Ingram discussed the situation in Nebraska. Nebraska is working to provide all teachers and students in the State with Internet access. The Educational Service Units (ESU) is responsible for providing Internet access to the schools in their service areas. The equipment was funded through a 1/2 cent per $100 valuation levied by the ESUs. The individual schools are required to pay their own connection costs. The suggested model is a leased 56 K line for a fee of $155 per month. There is also a $6000 to $8000 investment by the school

in equipment to support multiple students/teachers on-line simultaneously. This assumes that the network in the school is already in place.

Sharon noted that this model is not equitable and that many schools cannot afford the leased line or the long distance calls and moreover not all the schools are members of ESU.

Ken Wilcox provided details about DMSnet Project. The DMSnet Project would establish at Davison Middle School a combination building wide LAN and a community service BBS. The total cost of installing the system is $150,000

The LAN is to be designed with a high speed backbone and to include connections in each classroom as well as the library and office areas. The initial configuration is to be Apple Macintosh-based, but all connectivity is to be designed to accommodate DOS-based machines. The design will also take into consideration future connections to the planned ISD Internet node and so are to be TCP/IP capable.

Bill Wright entered the discussion and described the unique needs of rural teachers and students. In these areas, the cost of full Internet access is out of the question. Nonetheless, the teachers and students are eager to telecommunicate. How can these needs be best accommodated.

6   Summary of On-line Financial Discussion (II)

— by Sharon Ingram, Group Co-Facilitator

Trying to figure out the cost of networking and how we can finance it is almost an insurmountable task, but our group attacked the issues with vigor! Approximately a dozen people contributed on a fairly regular basis to these discussions.

1. One of our first points of agreement was on a tiered structure to networking:
    - The first tier would be a local area network. [The consensus was that without a local network there would still be limited access to Internet.]
    - The second tier would be a transitional tier with dial-up access; a good vehicle for learning and experimenting but not for wide use.
    - The final tier would be a full connection to Internet. The final tier, although appearing to be expensive at first glance, offers the greatest benefit to the largest number of people and therefore the costs can be spread out over a wider surface.

2. To achieve any of these tiers it was suggested that we needed extensive co-operation/collaboration among the local, state, regional and national entities for FUNDING purposes. The suggestion was made that possibly NSF could fund planning grants as incentives for this cooperation to take place.

3. Along with setting up the network hardware, there were a number of additional costs that were discussed, including other hardware that would be needed, training for teachers, staff and students, curriculum development costs, software, facilities modification and access costs. These costs vary greatly from one area of the country to another and this is a concern. We also wanted to provide access to the greatest number of people through home, school, library, museum, etc. connections.

4. Figuring out the benefits side of the coin is a much more esoteric problem. Many of these benefits are intangible and are associated with such things as greater student enthusiasm, etc. However, we felt that there would be cost savings since there could be more effective management of resources, on-line training could be provided at a cost savings and professional collaboration/cooperation could also lead to cost savings. There was concern that the benefits side of the coin does need to ,be quantified to provide the statistics that could persuade administrators and school boards to jump on the bandwagon and get their schools connected to Internet in a timely manner.

7   Summary of Reform On-line Discussion

— by Beverly Hunter, Group Co-Facilitator

This is a summary of the discussion on the educational reform context for networking conducted from October 4–13, 1993, via LISTSERV.

Participants

Twenty-three persons participated, contributing approximately 170 messages. Ten are classroom teachers in elementary or secondary schools; in addition nearly all of these have some professional responsibilities related to technologies. Three participants are administrators or consultants at the regional, school district, or state level, with responsibilities for technologies. Three are university faculty in teacher education. Two are executives of professional organizations (NEA and CSSO). Two are federal government officials with responsibilities related to either education or technologies or both. One is a program officer in a private foundation. One is in a research and development organization, and one is a private industry provider of telecommunications-based services to education.

Questions Addressed

The participants addressed the following questions about Educational reform and restructuring for a technology-intensive society:

The Big Question: Where does computer networking fit into the reform picture? Can we summarize a broad consensus about this?

- How does networking support educational reform?

- How does networking affect professional development?

- What evidence do we have for these effects, and how do we validate that evidence?

- How does networking help administrative productivity improvements and management reform? For example, does it support site-based management? How do we know?

The participants in our discussion do agree strongly on the ways in which computer networking can support reform. They point out, however, that there is NOT consensus on reform goals within either the ranks of professional educators or the general citizenry.

Some General Themes, with Sample Statements by Participants

1. Educational reform is a process, rather than some envisioned end state. That process is fundamentally a matter of communication, the creation and sharing of ideas, information and activities. Viewed in this manner, the role of networks in reform becomes obvious.

2. Change is difficult and people need help in coping with change. There is not consensus on reform across the educational establishment, e.g.:

> **"It will take more than access** or mandates to make intelligent users of networking. Most of all, it will take shifts in beliefs. Teachers will need to be allowed to make changes (why should they take a chance on networking when other chances they have taken have not been supported). Changes in administrative power structures and changes in classroom power structures."

> **"If education were the search for resources** to help answer authentic questions that individuals and small groups of children have, then the network would seem like a solution. If the school boards, supers, principals, and dept. heads call all of the shots, mandate the text, ban the books — well then...."

> **"If the information on networks is to be valuable** to reform, then those who would be reformed (we the teachers) must first believe that constructing knowledge is more important than finding curriculum. If teachers and their students are about pursuing questions, long-term projects, anchored challenges, and the like, then the net is filled with exciting information in the forms of people, text, pictures, sounds, and so forth. On the other hand, if the reformed are looking for THE CURRICULUM, then a better reform technology would be one-way video."

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3. If networks are to support reform, then we must speak of participation, not just access; we must be connecting, not just delivering. Example comment:

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"My vision for networking is based on a simple semantic distinction. When speaking about networking I believe that the operative verb should be CONNECTING and not DELIVERING. Most network managers are still focused on pouring things into people's heads as opposed to connecting them and thus truly empowering them. Thus while the semantic distinction is simple it is also profound. As Frank quoted, education is about "learning" not "knowing". The replacement for schools in the future will be true learning communities. Each individual will be "nested" into several learning communities, some close to home and some far away."

4. The networks are not just for the purpose of sharing ideas ABOUT reform. Rather, the interconnection of people, information, and computational resources, provides the context and mechanism for participating in new kinds of learning activities and challenges. That is to say, the networked collection of people and resources, if appropriately configured and supported, can BE the reformed educational environment.

Two Tough·st Issues

1. Lack of agreement among educators and citizens as to the nature of desired reforms, both in learning and teaching and in management of schools.

2. Educators not understanding the technological possibilities, and not participating in the policy debates that affect the information infrastructure.

How Does Networking Support Reform?

In general, by expanding the learning environment beyond physical classroom walls: breaking down barriers between school and the "real world."

Project-based learning is an important paradigm well supported by networking. Sample comment: "Networks can support projects-based educational experiences in which teams of students, outside experts, and teachers work collaboratively to solve real world problems or create products of relevance to students. This approach makes it possible for students to participate in knowledge construction, leaving a record of their efforts in the net "literature."

Project-based learning is supported by networking in many ways. Learners have access to primary information sources; resources developed in other sectors such as health care and atmospheric research. They can interact with

experts who are practitioners in the disciplines relevant to the projects. They can interact with persons having knowledge, concerns and experience in other cultures and environmental contexts. They can address global issues such as environment and population control. They can DO science, or social studies, or publishing, not just learn ABOUT these subjects.

Networks support more authentic and contextualized learning, by enabling learners and teachers to participate with practitioners in a subject or problem area, and by providing real audiences for the students' and teachers' work.

Networking supports efforts to help learners(including teachers) become more autonomous and independent in their learning. Students and teachers can initiate projects. They are able to locate resources that enable them to be creative and address complex questions and problems.

Networking can be a stimulus to reform:

> **"One cannot telecommunicate** *and* teach/learn effectively in the 'traditional' manner. One's role as the holder and dispenser of all classroom knowledge is destroyed by telecommunicating. Students become seekers of their own answers, and are empowered to take charge of their own learning."

Networks help teachers participate in the real work and community of their disciplines:

> **"I also hope the networks support** practicing scientists, mathematicians, etc. in sharing their trade with teachers and drawing teachers participation in and into a greater understanding of what it means to be'or practice in these fields."

Networking can help in the transition from the knowledge transfer model to the knowledge construction model:

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> "**First, networking can help destroy** the grip textbooks have on the curriculum. Using textbooks as the primary source of information in a classroom tends to support the knowledge transfer model. If information is fluid and changing — being both created and destroyed in the process — and if students must become information consumers, shopping around the net to find the resources they need to answer their questions or solve their problems, learning may become an active, rather than a passive activity (a caveat — computers and networks are pedagogically neutral. Poor teachers can make poor use of them just as good teachers can make good use of them to support learning)."

Networks can support the learner and teacher in addressing more complex problems:

> "**I really do feel that technology** is empowering and permits us to explore more real situations and do much more interesting problems (as well as give access to overwhelming (and overwhelmingly disorganized) resources). However, it also begins to structure how we view problems and how we work towards solutions. With the networks, technology has given us new hope. Who ever thought ten years ago that computers could be used for collaboration, socialization, conversation and revitalization."

Networks provide a context in which learners and teachers are challenged to deal with information capably and analytically.

The networks make it possible for teachers to have a say in reform decisions. Networks make it possible to facilitate more bottom-up reforms, encourage local initiatives for reform.

Parents and other community members can participate more in reform discussions and decisions.

Networks help the change agents and leaders of reform to help their colleagues. Many participants in our discussion told of ways they were able to assist their colleagues by getting info for them from the networks.

Professional Development

If we think of professional development as being similar to learning in general, then the same aspects of networking that are good for students are good for educators.

Teachers can help each other in the change processes, for example the networks can facilitate team teaching and discussions about pedagogy among teachers. Teachers can find colleagueship in virtual communities that they may not find in their physical school. They can interact with expert practitioners in their field as well as other teachers.

> **"By connecting the fragmented process** of preparing new teachers (e.g. 'Teacher-Net' in which preservice teachers, college faculty, and supervising classroom teachers continue to carry on a professional dialogue AFTER the student is placed for student teaching and beyond the initial placement period through the students' first year in their own classrooms). By providing opportunities for ongoing professional development (e.g., in-service education classes, access to experts in reform and pedagogy, professional dialog between classroom teachers, access to archives of information and effective models). In short, by breaking the isolation of the profession."

> **"Networking can make it possible** to support teachers who want to make the move to such an approach, breaking the isolation of the individual educator."

School Management Reform

How does networking help administrative productivity improvements and management reform? For example, does it support site-based management? How do we know?

In a fully networked environment, it is not necessary to organize schooling into the very large physical schools, isolated from the community and parents, that have so many negative consequences:

> **"I envision small community schools** within easy walking distance of homes, or even in the homes, where parents, kupuna [grandparents], and children of all ages, come to be active learners. Via the Internet, interactive TV, telephone, snail mail, and other technologies, students in such an environment can tap into global databases, libraries, individuals, and each other."

Such a school today could have access to the whole worldwide web of knowledge and expertise, thus avoiding the isolation and resource limitations

that caused such schools to be closed and consolidated with distant large schools in the name of management efficiency.

> **"The network really might help** us to build local communities who can share in the governance of the school. At the very least, they certainly could help us get the message from the staff to the community about what we are trying to accomplish and where we cold use their help. That open communication year round would be a huge first step and would build some trust. Think if the local cable station gave your school a channel connecting to every home in your area. What kinds of things would you put up on the screen each night? Now add interactive TV where parents could punch in a code and see what current information you wanted to send them about their child. Is this a threatening vision? It is part of building a community that is capable of site-based management."

Problems

Participants in this group raised some of the obstacles they see to widespread and large scale use of networks in support of reformed education.

Information overload:

> **"I also experience one of the down sides** of networking. With two Internet addresses and several networks and locations I am literally swamped with messages. I am not sure how one reads and then reflects on 50 to 75 messages a day. I suppose you mostly read and try to maintain a sense of the discussion."

Ownership of networks, information and tools:

> **"Who pays and what intellectual property** rights mean in this new world are all up for radical changes. It seems to me that we must reach an agreement that these resources should retain the concept of public switched universal services."

Lack of educator participation in policy debates:

> **"Educators in general have not been** particularly sophisticated in dealing with the FCC and state public utility commissions. In fact from my perception some of the new legislation with respect to NII this year could significantly limit the kinds of education access we now have."

Tools and systems:

> "**Software: solutions which work** very well in corporate environments can have some serious shortcomings in schools even when used ostensibly for the same purpose. Unfortunately, most IT hardware and software is designed primarily with business in mind."

Importance of INTERNETWORKING and open systems architecture, and the need for systems that are FAR easier to install, operate, maintain, and use than today's. For example:

> "**Is there some vision of the Internet** that allows me to access people who are struggling with similar problems? Should those responsible for evolving the network into something suitable for educators deal with these issues?"

Difficulty of teacher change:

> "**The need for students to become** comfortably skilled in dealing with information demands new roles for teachers as coaches, a major change for many and one which sometimes seems slow in coming."

Technologists and policy makers do not understand schools.

> "**I have found that those who are not connected** with public K–12 education do not realize the constraints under which schools operate, and do not understand how valuable a resource Internet use is to high school students."

Information is not education.

Stories

Participants in the Reform discussion told many stories of their experiences with networking in their schools. Here are some of their stories.

> "**Technological innovation in schools** should focus on building infrastructure, adapting existing tools to support curricular goals, providing support — both in the use of technology and its application to educational environments — with the goal of creating a sustainable system, and if possible

encouraging teachers to author their own curricular software tools. Our project has basically followed along those lines. Three years ago Archaeotype, a computer-based archaeological excavation that replaces the sixth grade curriculum, was featured on the PBS show *Innovation*. That project, based on a physical excavation done by primary school teachers, was developed on a shoestring with funds that came from the schools' operating budget. It was developed by two Dalton faculty and programmers, and four computers were purchased for its implementation in a classroom. Over half the funds required for developing that project went into personnel — both to develop the software and to support its use. Each of the three years since, increasing numbers of faculty have volunteered to develop projects, and today that one project has multiplied a number of times to the point where most of the school is involved and the projects are very much part of the Dalton experience."

"**We tried to answer the question** of direct linkage between connecting teachers and researchers a year ago in the preparation of several papers for presentation at the annual American Education Research Assn meeting. We did an analysis of three areas — curriculum, assessment, and structure. In each case we found that the interaction and collegial reflection did lead to real change in the school. For example, in the assessment area, several teachers from Washington and Kansas began a conversation about authentic assessment techniques in the elementary school. That lead to on-line discussion, the inclusion of others, seeking help from the researchers on-line, and finally a commitment to begin an action research effort in several schools. Further, there was commitment to inform each of the participants of their respective efforts and share and help each other. Specific action was taken and in at least two schools assessment using portfolios with students making regular presentations to the teacher and the parents became the practice. In one school regular grading (A, B, etc.) was eliminated. In the Kansas district, the work is now spreading to other schools. Yes, reflective dialogue can lead to school change and reform. But that will not happen if the networking concentrates on delivering information. To move from information sharing to professional development means moving to build affinity groups or learning communities were trustful, open, and sharing dialogue and reflection is the norm. It isn't sufficient to merely hook up the plumbing."

Participants in the Reform discussion told many stories of their experiences with networking in their schools. Here are some of their stories.

"I am the sole regular user of Tenet and the Internet in my district. I constantly talk to the other SBDM Committee members about how we can learn from others and share ideas through on-line brainstorming. No one has become as involved as I have, yet they are now beginning to communicate through me. For example, as we discussed an absence policy that we are about to implement at our high school (a responsible adult will have to reinstate a student each time he or she is absent....we compromised and will begin that requirement with the third cumulative absence); the superintendent indicated that he would not support the plan if we could not find other schools that had successfully implemented the idea. (I believe his thinking was to base all innovations on existing research....you know, research-based or data-driven decisions.) I volunteered to post it to the K–12 Admin network. We did not find anyone who was using the plan, but we did receive several suggestions...hence our compromise. We have also asked for experiences with different block schedules, and a few other ideas that I don't remember off-hand. However, teachers are beginning to see the value of communicating farther afield than the boundaries of Texas. A couple of weeks ago, a teacher who, for two years, has wanted to re-work the two-week sex education program to include more time and more information. Because the original development was approved by ONE individual who is somewhat removed from the classroom, what the teachers are allowed to offer is very limited. The sex-ed teacher asked me to find an outstanding program so he could have something on which to build his case for a semester-long curriculum dealing with relationshi /s as well as procreation. We received some wonderful respons :s.....from Canada, no less! (Others, too.) That's where we stand now, but at least he (we) can contact someone with existing programs that we may be able to adapt to our needs. Just yesterday, our art teacher asked me to see if other schools have student-created murals. The site-based committee in charge of brightening the school are at a stalemate over how much freedom to allow the students in their designs. Teachers fear the murals will look like graffiti instead of paintings. I haven't posted that request yet, but

I will. In a sense we are as isolated here by distance as people in other regions are isolated by mountains or water. Hence, I believe that networking within the school will alleviate the isolation of individual teachers (who until now close their doors and do their "thing" with educating youngsters) and networking BEYOND the school will give us a less provincial outlook. I feel that campus networking is only the first step. Many will balk at more than that (and even that) to begin with. Also, in conducting a workshop last summer in nearby Lubbock, I had a teacher sit through one of my very exciting (of course!) presentations with a glazed look on his face. I sought him out during the break to see why I could not get beyond the "wall" that I sensed. His statement was, 'I am required to be here, but when I have to start using computers, I'm retiring!' Now that man was probably YOUNGER than I am (but had been teaching longer), but perhaps it IS time to force his retirement and REQUIRE computer use in routine daily record keeping as a start. I can go on and on...but I'll give you a breather until next time! Thanks for asking, Beverly!

"We've had easy-to-use interface software to the Internet for 4 years, yet only last semester were routine campus announcements placed on e-mail. Those who use e-mail have important correspondents outside of the campus — important enough to chat with several times per week. I know of no other faculty member who is a member of a list or user group (although several students are). No faculty member understands what a gopher server is (including my chair, dean, or any member of any promotion committee) even though we have one of the few ed gophers in the world."

"Our state has just passed a major educational reform bill, leading to a performance-based system by the year 2000. I think telecommunications can play a major role in helping school districts and buildings share ideas, successes, and failures with each other in this effort, and providing a new and tremendously rich information resource for students and educators to change the way schools work. As the isolation of educators and students is reduced, on-going "life-long learning" (now only a buzz-word) can become a reality, and I am excited about the possibilities that this creates for professional development and sharing "best practices" among educators. The bottom line, though, must be what's in it for kids, and so it's critical that we

not focus solely on administrative productivity (as important as this is), but on how telecommunications will be used in the learning process."

What evidence do we have for these effects, validate? Specific example: recent problem with approval of reading materials in English class; found in conference For-English-Teachers-Only how another school had handled; same solution as we had determined, but more elaboration on procedure.

How does net help admin product, support site-based? Recent requests either entered or seen on conferences: science curriculum, when to intro biology, does earth science remain part of curr; how to do lunch periods; seven period day vs. block. .these are a few of the topics accessible to administrators on networks. Again and again it comes back to access to information and communication across the spectrum. More information creates better informed choices. In the Global Lab project led by TERC, thousands of high school students and their teachers in 16 countries around the world are participating in collaborative investigations of local and global ecological issues. Global Lab can tell hundreds of stories about ways in which the collaborative communities made possible by the networks, are making it possible for students and teachers to conduct original investigations, develop skills of scientific research, broaden their understanding of different cultures and environments around the world, and become initiators of research in collaboration with practicing scientists. Global Lab is just one of many such collaborative virtual communities of learners, teachers and experts.

8 Summary of Training/User Support On-line Discussion

— by Libby Black

We seem to be focusing on training mostly. The points raised are described below.

Components suggested as important in training:

- hands-on

- on-going training opportunities and support user support groups and district tech support

- relevance

- ease of use

- good documentation

- models of use

- teachers should be compensated for training time (paid, credit etc.)

- pre-service ed must include technology education

- pre-service ed must contain global element

- pre-service ed must contain change theory and methods of collaboration

What else?

Other questions:
What do we think about monitoring teachers for compliance?

Do superintendents drive the ship and if so, how do we steer them in the right direction?

How do we reach the educators who do not feel they are "computer literate"?

At what granularity (state, district, regional, building) level should training take place? [It seems that we tend to be focusing on building level (maybe district level?) training]

Who should be the principal contact person (people) in that particular level?

9 Summary of Training/User Support On-line Discussion

— by Marion French

Training for educators needs to include some of these elements to be successful.

Hands-on and On-going

Teachers that are most successful get a good dose of hands-on training, but they need to have continued access and support to use telecommunications in a meaningful way. The teachers with a computer available to them at school or at home are more likely to use telecommunications as an integrated part of their teaching. Training series as in-service can help this process and provide peers for support.

Relevance

Teachers are too busy with teaching children to take much time on a technology that does not have some impact on their classroom or professional development.

Ease of Use

The easier and more intuitive the on-line system the sooner the teacher has mastery over the basics and can focus on the business of teaching.

Good Documentation

The more concise, yet complete, the better.

Models of Use

By seeing a variety of uses across — disciplines, grade-levels and specific to their own classes gives people a place to start. Participating in a model project and then developing their own also gives educators a good start toward evaluating what works best for them and how to directly involve their students.

Characteristics of Successful Models for Training and Support

1. How are users in your community trained?
Who provides support? List successful approaches as well as failures. (I remind my students that we can learn much from those "bad" science projects...what to avoid next time!)

A. Need for flexible models for different scenarios

1) Rural, urban, suburban

2) Availability of funding, personnel and expertise to carry out plan

3) Interest and political implications of who will pay and best support

4) Understand the realities of busy educators and schedules

5) Change is a process not an event

6) Phased plan for training and support

7) Access needed from the classroom and help services from the classroom

8) Scheduling considered to allow flexible access to telecommunications for all users (students, teachers, administrators)

9) Organizational and instructional planning need to be tied to technology planning

B. Systemic change: focusing on the "why's" before the "how-to's" and having educational need drive the organizational technical and instructional changes

1) Superintendents need to lead the move for systemic change

2) Building principals or local administrator most effective in implementing at building level

3) Coordinated technology coordinators, grassroots change agents through example and education of administrators can help to set the agenda.

4) Implementation through monitoring faculty vs. empowering (point of debate-inspection v. expectation)

5) State level buy in and coordination necessary

6) Change must meet local needs

7) Funded adequately for equipment and support over time

8) Research based and in line with national trends

9) Substantial change to the entire organization is necessary

C. Trainers and support personnel

1) K–12 background or sensitivity
2) Designated position of professional or paraprofessional
3) Graduate interns
4) Trainers from the state or county level
5) Students from ages 8–18 that learn technology and teach teachers and peers (carefully trained and supervised by a coordinator)
6) Library or media center personnel
7) Volunteers from business, library, higher education, parent organizations
8) Ongoing availability of personnel
9) Systems on the net or at locality (help desk, on-line, telephone)
10) Mailing discussion lists in subject area or general K–12 list give supportive community of peers
11) Need for technical position in the district
12) State or county level trainers may train district trainers
13) Positions of Instruction Resources Teachers to work closely with teachers

D. Pre-service and in-service

1) Certification requirements for pre-service or those in the field from the state level
2) Need for relevant training for teachers in use within technology with focus on reform, collaboration, change theory, and global element
3) Need for administrators to understand general technical, curricular uses of technology and know how to use strategic planning for support and budget issues

E. Characteristics of successful training and follow-up

1) Hands-on with relevant examples and real products/systems from the Internet or other telecommunications systems
2) Ease of use of machines, software
3) Clearly relevant to educators involved in training
4) Clear concise documentation
5) Personal attention by trainers and support
6) Continued access to machines, phone lines

7) Plans for support and implementation clear to those being trained

8) During school time or time compensated

9) Time allotted for access after training regularly

10) Multilevel for neophytes through more experienced

11) Training in a variety of formats and learning styles

12) Introductory in-service over multiple sessions (4–10 hours)

13) Teaching empowering skills which allow teachers/students to help themselves
   a) Explain why telecomputing is needed and need for district commitment
   b) How to navigate the net
   c) Find mentors
   d) Write successful calls for collaboration
   e) Find FAQs — frequently asked question guides
   f) How to find discussion groups of interest
   g) How to find relevant resources

14) Follow-up: availability of equipment, support and projects to implement what is learned

15) Phased training: print, non-Internet telecommunications commercial networks (i.e. AOL) then full Internet

2. Addressing the needs of users at different levels.

What are the needs of your users? What is being done at elementary, middle, and high school levels? What are major demands in industry, the universities? What are the future trends in this technology?

A. General needs

1) Technology-organizational-instructional planning integrated

2) Adequate support and follow-up for continued diffusion

3) Systems which support self-initiated, self-applied solutions most effective

4) More access, equipment, training and support

5) A method for keeping the toll calls to a minimum

6) Methods for incorporating telecomputing to enhance the academic subject areas and not disrupt the school's curriculum.

7) Finding methods for incorporating telecomputing in a one computer classroom.

8) Support network that allows the tech. coordinator to disseminate information and support to other trainers (faculty, students)

9) Long-term technology planning that takes on the expertise of community members

10) For neophytes: road show presentations and information to share with administrators

B. Elementary

1) Need designated person for support, less able to rely on students as help due to age

2) Parents and community very helpful

C. Middle Schools

D. High Schools

E. Small districts

1) May not have adequate budget or expertise to give support

F. Future directions

1) High speed lines (56Kbps minimum)

2) More user-friendly front ends

3) More use of graphics and images (satellite, etc.)

4) Multimedia and desktop video widely available

5) Easy dial-in access from home or work

6) Accessibility from every classroom over a Local area network

7) Wireless communications

8) Increased organizational and instructional infrastructure driving technology uses

9) Increased money on technology and training

3. Coordinating services

Are there any cooperative projects being done at your location? In your experience, where do the most successful coordinating efforts come from (not necessarily related to telecommunications)? Who best provides initiative and direction? Local (Grass Roots?), State, Federal levels?

A. Local

1) Community partnerships to get used equipment from business to repair and donate to schools

    2) Partnerships with business to provide expertise, mentors

    3) Parent organizations to educate other parents and volunteer

    4) District technology and support planning involving all levels

    5) Positions dedicated to meeting and supporting technology plans

    6) Adequate funding

    7) District level technology positions with a network of supporting staff (train the trainer)

    8) University and industry expertise collaborative programs

B. County or Regional Centers.

    1) County education offices that provide training/support resources

    2) Centers set up by pooled resources of small districts to meet training/support needs on an ongoing basis

C. State

    1) State education departments providing network/training support personnel

    2) State university networks providing access to schools

4. Ethical training and induction systems.

What are your network community's guidelines for appropriate use and ethical behavior? How are ethical guidelines relayed to your users? How is inappropriate or unethical behavior handled?

    A) Penalties of losing accounts

    B) Signing contracts

    C) Acceptable uses during class time (tool not toy)

    D) Acceptable resources and graphics

    E) Parent information/permission forms

    F) Codes of Conduct:

        •Educational Use Guidelines   •Courteous & Ethical Behavior

        •Respect for Privacy   •Legal Responsibilities

        •Personal Responsibility   •Cooperative Assistance

        •Copyright Guidelines   •"Computer Abuse"

    G) Local programs on etiquette and acceptable use policy

Appendix III:
CoSN-FARNET Project
Bibliography

General Reference Books on the Internet and Internetworking

Estabrook, Noel. *Internet and Education.* 1993.

Estrada, Susan. *Connecting to the Internet* (ISBN 1-56592-061-9). O'Reilly & Associates, 103 Morris Street, Ste A, Sebastopol, CA.

Fraase, Michael. *The MacInternet Tour Guide: Cruising the Internet the Easy Way* (ISBN 1-56604-062-0). Ventana Press, Inc. P.O. Box 2468, Chapel Hill, NC, 1993, 288 pages.

Frey, D., Adams, R. *!%@.:: A Directory of Electronic Mail Addressing and Networks* (ISBN 1- 56592-031-7), O'Reilly & Associates, 103 Morris Str, Ste A, Sebastopol, CA, 1993, 458 pages.

Gargano, J. *Mining the Internet.* University of California, Davis, CA, 1991

Hardie, E.T.L., Neou, V. *Internet Mailing Lists.* 1993 Edition (ISBN 0-13-327941-3). PTR Prentice-Hall, Inc., 113 Sylvan Avenue, Englewood Cliffs, NJ, 1993, 356 pages.

Internet Society. *Proceedings of INET'93.* Held San Francisco, CA, 17-20 August 1993. Internet Society, 1895 Preston White Drive, Suite100, Reston, VA.

*Kehoe, Brendan P. *Zen and the Art of the Internet* (ISBN 0-13-010778-6). PTR Prentice-Hall, Inc., 113 Sylvan Ave., Route 9W, Englewood Cliffs, NJ.

*Kochmer, Jonathan. *The Internet Passport: NorthWestNet's Guide to Our World On-Line* (ISBN 0-9635281-0-6). NorthWestNet, Bellevue, WA, 1993, 516 pages.

*Krol, Ed. *The Whole Internet Users Guide and Catalog*. (ISBN 1-55558-033-5) O'Reilly & Associates,103 Morris Str, Ste A, Sebastopol, CA, 1992, 400 pages.

Lindner, Paul. *Internet Gopher User's Guide*. University of Minnesota, 1993.

Malamud, Carl. *Exploring the Internet: A Technical Travelogue* (ISBN 0-13-296898-3), PTR Prentice- Hall, 113 Sylvan Avenue, Englewood Cliffs, NJ), 1992, 379 pages.

Marine, A., Kirkpatrick, S., Neou, V., Ward, C. *Internet: Getting Started*. (ISBN 0-13-327933-2),PTR Prentice-Hall, Inc., 113 Sylvan Avenue, Englewood Cliffs, NJ), 1993, 360 pages.

NCSA. *An Incomplete Guide to the Internet and Other Telecommunications Opportunities Especially for Teachers and Students K12*. NCSA, 1993, 291 pages.

Parker, Tracy LaQuey, with Ryer, Jeanne C. *The Internet Companion:A Beginner's Guide to Global Networking*. (ISBN 0-201-622249), Addison-Wesley, One Jacob Way, Reading, MA, 1993, 196 pages.

Quarterman, John. *The Matrix: Computer Networks and Conferencing Systems Digital Press*, Bedford, MA, 1991.

Sanderson, David. *Smileys* (ISBN 1-56592-041-4), O'Reilly &Associates, 103 Morris Str, Ste A, Sebastopol, CA, 1993, 93 pages.

Smith, Prescott. *Educator's Guide to Email Lists*. August 29, 1993.

Smith, R., Gibbs, M. *Navigating the Internet*. Sams Publishing, 1993.

Tenet, Roy. *Internet Basics*. Prepared with Funding from the Office of Educational Research and Improvement, U.S. Department of Education, September 1992.

General Reference Magazine and Journal Articles on Networking

"America's Shame." Special section on educational technology in the schools. *MACWORLD*. Sept. 1992.

"Highways of the Mind or Toll Roads Between Information Castles?" *Point*, 1991.

"Telecommunications," *Bread Loaf News*, Fall/Winter 1992, Vol. 5, No.2.

Markoff, John. "Building the Electronic Superhighway," *New York Times*, January 24, 1993, 3:1:1.

Sterling, Bruce. "Internet," in *The Magazine of Fantasy and Science Fiction*, February 1993.

United States Government Publications on Education and Networking

Clinton, William. J. *The National Information Infrastructure: Agenda for Action*, 1993

Clinton, W.J., Gore, A., Jr. *Technology for America's Economic Growth, A New Direction to Build Economic Strength* (ISBN 0-16-041692-2). February 22, 1993. US Government Printing Office, Washington, D.C. 20402-9328.

Copple, Carol. *SCANS in the Schools*. Washington, D.C.: Government Printing Office, 1990, 111 pages.

Department of Labor. *Skills and Tasks for Jobs: A SCANS Report for America 2000 Commission of Achieving Necessary Skills, Department of Labor*. Washington, D.C.: Government Printing Office, 1992, 545 pages.

FCCSET. *Grand Challenges: High Performance Computing and Communications*. Committee on Physical, Mathematical, and Engineering Sciences. Washington, D.C.: Executive Office of the President, Office of Science and Technology Policy, Federal Coordinating Committee on Science, Engineering, and Public Policy Panel on Information Technology and the Conduct of Research. Washington, D.C.: National Academy Press, 1989.

*FCCSET. *Pathways to Excellence: A Federal Strategy for Science, Mathematics, Engineering and Technology Education*. Committee on Education and Human Resources of the Federal Coordinating Council for Science, Engineering, and Technology. U.S. Science, Mathematics, Engineering, and Technology Education Strategic Plan, FY 1994–1998, EP-288.

Gore, Albert. *From Red Tape to Results: Creating a Government That Works Better and Costs Less*. Vice President Gore's Overview Report.

Hunter, Beverly. "NII Report from Woods Hole," by ARPA ISAT Summer Study on the NII, August 18–24, 1993.

OTA. *Power On! New Tools for Teaching and Learning.* U.S. Congress, Office of Technology Assessment. Washington, D.C. Government Printing Office, 1988.

OTA. *Rural America at the Crossroads: Networking for the Future.* U.S. Congress, Office of Technology Assessment. Washington, D.C. Government Printing Office, 1991.

Context: Restructuring and Systematic Changes

Byham, W.C., Cox, J., Shomo, K.H. "Zapp!" In *Education: How Empowerment Can Improve the Quality of Instruction, and Student and Teacher Satisfaction.* (ISBN 0-449-90796-1), Ballantine Books, New York, 1992, 244 pages.

Collis, B., Carleer, G. *Technology-Enriched Schools: Nine Case Studies with Reflections* (ISBN 1-56484-017-4) ISTE: 1787 Agate Street, Eugene OR, 1992, 145 pages.

Cullen, David. "Integrated Classrooms and Administrative Networks." Technology coordinator of the Greensburg Salem School District, Greensburg, PA. *Educational IRM Quarterly,* Summer 1993, Vol. 2, No. 4, pp. 19–22.

Dickinson, Dee. *Positive Trends in Learning* (ISBN 0-924667-99-0). IBM Educational Systems, 1991, 36 pages.

Fiske, Edward. *Smart Kids, Smart Schools: Why Do Some Schools Work?* Simon & Schuster, NY 1991.

Gardner, Howard. The Unschooled Mind: How Children Think and How Schools Should Teach (ISBN 0-465-08896-1), BasicBooks, NY, 1993, 241 pages.

Hodas, Stephan. "Technology Refusal and the Organizational Culture of Schools v.1.2." Electronic Report.

*Hunter, Beverly. "Internetworking: The Coordinating Technology for Systematic Reform in Education." Invited Paper for Special Issue on Technology and Education, Communications of the ACM. Submitted for publication, October 1992.

Levin, R., and Philipo, J. "Improved School-Based Management Through Intelligent Networking." T.I.E. November 1990, Vol. 18, No. 4, pp. 69–71.

Loader, David. "Reconstructing an Australian School." *The Computing Teacher*, April 1993, Vol. 20, No. 7, pp. 12–15.

OERI. *Using Technology to Support Educational Reform*, SR Report #2882, ED Contract RR91172010 prepared by OERI.

Papert, Seymour. *The Children's Machine: Rethinking School in the Age of the Computer* (ISBN 0-465-01830-0). BasicBooks, A Division of HarperCollins Publications, 10 East 53rd St, New York, NY 1992, 241 pages.

Rutkowski, Kathy. "A Childhood Remembered: The Magic of Computer Networks.". Herndon, VA. NetTEACH NEWS, March 1993, Vol. 1, No. 1, p. 6.

Rutkowski, Kathy. "Chaos in the Classroom: A Cornu opia of Opportunity." Herndon, VA. *NetTEACH NEWS*, August 1993, Vol. 1, No. 3, p. 1.

Seymour, D., Seymour, T. *America's Best Classrooms: How Award Winning Teachers Are Shaping Our Children's Future* (ISBN 1-56079-076-8). Peterson's Guides, Princeton, NJ. 1992, 137 pages.

Taubes, Gary. "A Wired Classroom: American Education Goes On-line." Phi Delta Kappan, October 1990, pp. 109–112.

Thornburg, David. *Education, Technology, and Paradigms of Change for the 21st Century* (ISBN 0-942207-09-2). Starsong Publications, 1991, 143 pages.

Thornburg, David. *Edutrends 2010-Restructuring, Technology and the Future of Education* (ISBN 0-942207-10-6). David Thornburg and Starsong Publications, 1991, 1992, 168 pages.

Tye, B.B., Tye, K.A. *Global Education: A Study of School Change* (ISBN 0-7914-1041-2). State University of New York, Albany, NY. 1992, 273 pages.

* Waggoner, M.D. *Empowering Networks: Computer Conferencing in Education* . Englewood, NJ.: Educational Technology Publications, Englewood, NJ, 1992.

"TCT Restructuring Issues." *The Computing Teacher:* Vol. 18, No. 6, March 1991; Vol. 18, No. 7, April 1991.

Connectivity and Access

Bishop, Ann. "The National Research and Education Network (NREN): Update 1991." ERIC Clearinghouse on Information Resources, 1991.

*Buchanan, L., Redder, G., Swatz, D. *The K12 Internet Experience: A Project Overview of Providing Internet Access to An Entire School District.* Colorado State University and Rocky Mountain High School Report.

Bull, G., Harris, C. "Considerations underlying the architecture of a state public telecomputing network." Paper prepared for the Conference on Educational Telecomputing at the Technical Education Research Centers, Cambridge, MA, April 1991.

Burbank High School Technology Plan. 1993.

Crawler, John. *California Educational Technology Summit — Proceedings.* California Planning Commission, 1991, 75 pages.

Figalio, Cliff. *The Well: A Small Town on the Internet Highway.*

Hayes, J. "Getting Closer Together." Quality Education Data. *Educational IRM Quarterly*, Summer 1993, Vol. 2, No. 4, pp. 35–37

Kavanuagh, A. Bowden, P. *Improving Techniques for Information Use: The Blacksburg Electronic Village.* Blacksburg, VA. Blacksbury Electronic Village, 1993

King, K., Clement, J. "Toward a National Network Infrastructure for K12 Education: Final Report on a Fact-Finding Mission." Unpublished manuscript. Washington, D.C. EDUCOM, 1990.

Klingenstein, Kenneth. "Boulder Valley Internet project: Early Lessons in Early Education." Presented at INET'93, San Francisco, CA, August 17–20, 1993 and found in the INET'93 Proceedings pp. ECA-1–8.

McAnge, T., Harrington, M., Pierson, M.E. *A Survey of Educational Computer Networks*, Virginia Polytechnic University, Blacksburg, VA. 1990

Newman, D., Bernstein, S., Reese, P.A. "Infrastructures and School Networking: Current Models and Prospects." BBN7726, Bolt, Beranek and Newman, Inc., Cambridge, MA. 1992.

Newman, D., Bernstein, S., Reese, P. "Local Infrastructures for school networking: Current Models and Prospects." BBN Report No. 7726. Cambridge, MA: Bolt, Beranek, and Newman, Inc., 1992.

Richmond, L., Bergstrom, P., Kerlin, B. *The Virtual School System.* MP 92W0000008 The MITRE Corporation, McLean, VA, 1992, 87 pages.

Riel, Margaret. "Four Models of Educational Telecommunications: Connections to the Future." *Education and Computing*, Vol. 5, pp. 261–274.

Sackman, Gleason. "North Dakota's SENDIT — A First Class Educational Network." *NetTEACH NEWS*, April/May 1993, Vol. 1, No.2 p 3–4.

Stedman, D., Bransford, L. "Educational Telecommunications Infrastructures: Ferment, Flux, and Fragmentation." In *Institute for Information Studies. A National Information Network: Changing our lives in the 21st century.* Queenstown, MD: Wye Center, The Aspen Institute, 1992.

Stout, Connie. TENET-The Texas Education Network." *NetTEACH NEWS*, March 1993, Vol. 1, No. 1, pp. 3–4.

Strangelove, Michael. "Free-nets: Community computing and the rise of the electronic citizen." *Online Access*, Spring 1993, pp 46–47.

Technical and User Support

The Librarian's Yellow Pages, January 1993.

Andres, Yvonne. *CERF'n SAFARI: A Classroom Users' Guide to the Internet.* CERFnet: P.O. Box 85608, San Diego, CA. 1992.

Andres, Y. Jacks, M. Rogers, A.. *TeleSensations: The Educator's Handbook to Instructional Telecomputing.* The FrEdMail Foundation. Bonita, CA. 1991.

Austin, Tackett. *The Technology Advisory Council: A Vehicle for Improving Our Schools* (ISBN 1-56484-026-3). ISTE, 1787 Agate Street, Eugene OR. 1993, 152 pages.

Clement, John. "Networked-Based Collaborations: How Universities Can Support K–12 Reform Efforts." *EDUCOM Review*, Vol. 27, No. 1, pp. 9–12.

CORE. The Core Network: Acceptable Use Document.

Finkel, LeRoy. *Technology Tools in the Information Age Classroom* (ISBN 0-938661-34-5). Franklin, Beedle & Associates. 1991, 157 pages.

FrEDMail. *T'nT: Teachers and Telecomputing.* FrEdMail Foundation. Bonita, CA. 1991.

Horowitz, B., Negroni, P., Bolen, N. "Applications of Information System Technology to K12 Education (M92B0000088)." The Mitre Corporation, McLean, VA, 1992.

Hunter, Beverly. "Computer-based Network Support for Teacher Collaborations: Researching New Contexts for Both Learning and Teaching." Boston: American Educational Research Association paper presentation, 1990.

Hunter, Beverly. "Linking for Learning: Computer-and-Communications Network Support for Nationwide Innovation in Education." *Journal of Science Education and Technology*, September 1991.

Katz, M., McSwiney, E., Stroud, K. "Facilitating Collegial Exchange among Science Teachers: An Experiment in Computer-based Conferencing." Cambridge, MA: Harvard University Educational Technology Center, 1987.

Katz, M., Inghilleri, M., McSwiney, E., Sayers, D., Stroud, K. "Talking about Teaching, by Writing — The Use of Computer -based Conferencing for Collegial Exchanges among Teachers." Harvard University Educational Technology Center, Cambridge, MA, 1989.

Kearsley, G., Hunter, B., Furlong, M. *We Teach with Technology — New Visions for Education* (ISBN 0-938661-37X). Franklin, Beedle & Associates, 1992, 168 pages.

Kearsley, G., Lynch, W. "Educational Leadership in the Age of Technology." *Educational IRM Quarterly*, Summer 1993, Vol. 2, No. 4, pp. 12–16.

Merseth, Katherine K. "Supporting Beginning Teachers With Computer Networks." *Journal of Teacher Education*, March/April 1991, Vol. 42, No. 2, pp. 140–147.

Moursand, David. High Tech/High Touch: A Computer Education Leadership Development Workshop (ISBN 0-924667-52-4). ISTE, 1787 Agate Street, Eugene, OR, 1988, 200 pages.

Moursand, David. *The Technology Coordinator* (ISBN 1-56484-015-8). ISTE 1787 Agate Street, Eugene, OR. 1992, 192 pages.

NECC. Proceedings of the National Educational Computing Conference-NECC'91, NECC'92, and NECC'93. ISTE, 1787 Agate Street, Eugene, OR.

Ryba, Ken., Anderson, Bill. *Learning With Computers: Effective Teaching Strategies* (ISBN 0-924667-64-8). ISTE, 1787 Agate Street, Eugene, OR, 1990, 104 pages.

Sherratt, Christine. *Information Services Study: Final Report*. Cambridge, MA: MIT Press, 1992.

Virginia's *Public Education Network: Acceptable Use Policy*, April 1993.

Weir, S. "The Computer in Schools: Machine as Humanizer." *Harvard Educational Review*, Vol. 59, No. 1, pp. 61–73.

Wighton, David. "Telementoring: Examining the Potential for Educational Network." *T.I.E.* Vol. 4, Nos. 3–4, pp. 13–16.

Financial

Cradler, John. *The Analysis of the Impact of California Educational technology Regional and Local Assistance Programs*. FarWest Labs, 1991, 77 pages.

Cradler, John. *The Educator's Guide for Developing and Funding Educational Technology Solutions*. Harvard University, 1993.

Schickele, Sandra. "The Economic Case for Public Subsidy of the Internet." Presented at the Conference on Public Access to the Internet held at Harvard University, 1993.

Curriculum and Content

"A Network Primer: When a network is not a network." *Classroom Computer Learning*, February, 1988.

"Breaking down Barriers: High Schools and Computer Conferencing." In *Reimagining composition in the Virtual age*, Boynton-Cook/Heinemann, in press.

Andres, Yvonne. M. "The Global Schoolhouse: A Vision of Tomorrow." *NetTEACH NEWS*, Vol. 1, No..2, April/May 1993, p.6.

Brehm, Barbara. "The Places Project: cooperative Learning, Problem Solving, and Telecommunications to Enhance Learning." *T.I.E.* Vol. 4, Nos. 3–4, pp. 6–7.

Clements, John. "K12 Networking Benefits for Higher Education." *EDUCOM Review*, Vol. 26, No. 2, pp. 15–18.

Teaching Federalist #10: A Lesson Plan for High School Teachers. Boston University: Boston, MA. 1989

Bull, G., Harris, J., Drucker, D. "Building an Electronic Culture: The Academical Village at Virginia." in *Empowering Networks: Computer Conferencing in Education,* edited by Micahel D. Waggoner, pp. 35–53. Educational Technology Publications: Englewood Cliffs, NJ.

*Carlitz, Robert. "Common Knowledge: Networks for Kindergarten Through College." *EDUCOM Review,* 26 (2): pp. 25–28. Summer 1991.

Charp, Sylvia. "Networking K12." Final Report of a Study on Applications of Networking in Grades K–12 submitted to Kenneth King, May 4, 1990.

Clement, John. "Building a Consortium for School Networking." *EDUCOM Review,* Vol. 26, No. 3/4, pp. 15–16.

Copen, Peter. "The Globe Project: A place for our youth to make a difference by working together globally using telecommunications." Presented at INET'93, San Francisco, CA, August 1993. Contained in the INET'93 Proceedings, ECC-1–8.

Copple, Carol. *SCANS in the Schools.* US GPO, 1990, 111 pages.

Corcoran, Elizabeth. "Why Kids Love Computer Nets." *Fortune Magazine,* September 20, 1993, pp 103–108.

*Clark, C., Kurshan, B., Yoder, S. *Telecommunications in the Classroom* (ISBN 1-56484-006-9) ISTE. 1787 Agate Street, Eugene, OR, 1989. 74 pages.

Dalton, Marian. "Does Anybody Have a Map? Accessing Information in the Internet's Virtual Library." *Electronic Networking,* 1(1): pp. 21–29, Fall 1991.

Dede, Chris. "Potential Uses of Telecommunications to Empower Implementation of the NCTM Math Standards." *T.I.E.* Vol. 4, Nos. 3–4, pp. 17–20.

Dickinson, Sarah. "LogoNet: The Child As a Global Traveler." Presented at the International LogoConference in Caracas, Venezuela, 1993.

Department of Labor. *Skills and Tasks for Jobs: A SCANS Report for America 2000.*US Government, Department of Labor, 1992, 545 pages.

Eisenberg, Michael and Ely, Donald. "Plugging Into The 'Net." *The Eric Review,* Vol. 2, No. 3, Winter 1993, pp. 2–9.

Harel, I., Papert, S. *Constructionism* (ISBN 0-89391-786-9). 355 Chestnut St., Norwood, NJ: Ablex Publishing Co., 1991, 518 pages.

Harris, Judi. "Internet Resources Directory for Educators: Update." With the students of EDC 385G and TED 8000. 1993.

Horn, C., Severs, M., Shell, D. "Effects of a computer-based educational center on disabled students' academic performance." *Journal of College Student Development* 29, 1988, pp. 432–440.

Goldman, M., Newman, D. "Electronic Interactions: How Students and Teachers Organize Schooling Over Wires." Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA, 1988.

Hunter, Beverly. "Linking for Learning: Computer-and-Communications Network Support for Nationwide innovation in Education." Journal of Science Education and Technology, Vol. 1, No. 1, 1992, pp. 23–34.

Hyatt, Donald. "Getting Started with Supercomputing: An Approach for high school students." An unpublished manuscript, Thomas Jefferson High School: Arlington, VA, 1991.

Itzkan, Seth. *Student Recommendations for Global Networking in Schools: A Report from the First Global Classroom Youth Congress,* hosted at the World Future Society General Assembly, Washington, D.C., June 28–29, 1993. Prepared by Seth Itzkan, July 8, 1992.

Jensen, Eric. "At Risk Students On-Line." *The Computing Teacher*, Vol. 19, No. 4, December 1991/January 1992, pp. 10–11.

Kay, Alan. "Computers, networks, and education." *Scientific American,* Special Issue on Communications, Computers, and Networks, Vol. 265, No. 3, pp. 100–107, September 1993.

Keating, Pamela. *Achieving Excellence by Increasing Access to Knowledge.* Network Technology Task Force of the GOALS Panel, 1993.

Lederberg, J., and Uncapher, K. Toward a National Collaboratory." Report of an Invitational Workshop at The Rockefeller University, March 17–18, 1989.

Leland, Bill. "IGC Networks and education." TERC Conference on Educational Telecomputing Paper Presentation, April 18–19, 1991.

Lenk, Cecilia. "The network science approach to science and mathematics education." *The Network Science Experience Draft Manuscript*, 1991.

Levin, J., Kim, B., Riel, M. "Instructional Interactions on Electronic Message Networks." A Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA, 1988.

Levin, J., Waugh, M., Kolopanis, G. "Science instruction of electronic networks." *Children's Environments Quarterly*, Vol. 5, No. 4, pp. 19–23, 1988.

LCHR. "Kids and Computers: A Positive Vision of the Future." *Harvard Educational Review*, Vol. 59, No. 1, pp. 73–85.

Millsbury, Peter and Eisenberg, Peter. *LM_NET and the NII/NREN*, in progress.

Newman, D., Goldman, S., Brienne, D., Jackson, I., Magzamen, S. "Computer mediation of collaborative science investigations." *Educational Computing Research*, Vol. 5, No. 2, pp. 151–166.

Ohanian, Susan. *Garbage Pizza Patchwork Quilts and Math Magic:Stories about Teachers Who Love To Teach and Children Who Love To Learn* (ISBN 0-7167-2360-3). W. H. Freeman and Company, 1992, 248 pages.

OTA. *Linking for Learning: A New Course for Education.* (OTA SET-430) U.S. Congress, OTA, Washington, D.C., 1989.

OTA. *Power On! New Tools for Teaching and Learning.* (OTA SET 379) U.S. Congress, OTA, Washington, D.C., 1988.

Packer, Arnold. "Taking Action on the SCANS Report." *Educational Leadership*, Vol. 49, No. 6, March 1992, pp. 27–31.

Papert, Seymour. *Mindstorms: Children, Computers, and Powerful Ideas.* New York: Basic Books, 1980.

Reinhold, J. "Use of local area networks in schools." ERIC Clearinghouse on Information Resources. New York, 1989.

Riel, M., and Levin, J. "Building Electronic Communities: Success and Failure in Computer Networking." *Instructional Science*, Vol. 9, pp. 145–169, 1990.

Riel, Margaret. "Computer-mediated communications: A tool for reconnecting kids with society." *Interactive Learning Environments*, Vol 1, No 4, 1991.

Riel, Margaret. "Four Models of educational telecommunications:Connections to the Future." *Education and Computing*, Vol. 5, pp. 261–274.

Roberts, N., Blakeslee, G., Brown, M., Lenk, C. *Integrating Telecommunications Into Education*. Prentice-Hall: Englewood Cliffs, NJ, 1990.

Rogers, Al. "Linking Teachers and Students Around the World." FrEDMail Foundation, 1992.

Rose, Mike. "Are You Plugged into the Global Classroom?" *American Teacher*, May/June 1992, Vol. 76, No. 6, pp. 8–9.

Rutkowski, Kathy. "The Art of California Cooking and the Vision of K12 Internetworking." *NetTEACH NEWS*, Vol. 1 No. 4, September 1993, pp. 1–2.

Seymour, D., Seymour, T. *America's Best Classrooms: How Award Winning Teachers Are Shaping Our Children's Future* (ISBN 1-56079-076-8). Peterson's Guides: Princeton, NJ. 1992, p. 137.

Solomon, Gwen. "A Writing Class Taps into a World of Knowledge. *Electronic Learning*, March 1989, pp 16–17.

Solomon, Gwen. "Going online to expand the classroom." *Electronic Learning*, Special Supplement, pp.45–47.

Solomon, Gwen. "Hands-on Science Projects with Help from Online Networks." *Electronic Learning*, April 1989, pp. 22–23.

Tinker, Robert. "Educational Networking: Meeting Educators' Needs." From Proceedings of INET'93, ECB-1–11.

Trujillo, Gary. "NativeNet: Electronic Communications from the Artic to Amazonia and Beyond." T.I.E. Vol. 4, No.3–4, pp. 9–10.

Waters, Susan A. "Can Networking Encourage the Sharing of Practical Wisdom? — A View from Wells Junior High." Case Study presented at the Symposium on Audience, Notation, and Reflection: Toward Shared Practical Wisdom, Annual Meeting of the American Educational Research Association, April 1991.

Waugh, Michael, Miyake N., Levin, J., Cohen, M. "Problem Solving on Electronic Networks." Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA, 1988.

Waugh, Michael., Levin, J. "TeleScience Activities: Educational uses of Electronic Networks." *Journal of Computers in Mathematics and Science Teaching*, 1988.

Weir, Sylvia. "Electronic Communities of Learners: Fact or Fiction." Working Paper 3–92. TERC: Cambridge, MA, 1992.

Weir, S., Gal, S., Krensky, L. "Experiencing Science: Students' Accounts of Learning Science." TERC, Cambridge, MA, 1991.

Wright, William. "International Group Work: Using a Computer Conference to Invigorate the Writing of Your Students." *The English Classroom in the Computer Age*, NCTE, 1991.

Wright, William. "Telecomputing in Social Action." In *Social Issues in the English Classroom*, NCTE, in press.

Virginia's *World Class Education Plan*, September 17, 1992.

Rutkowski, Kathy. *The Tao of K12 Networking*. Herndon, VA. NetTEACH NEWS, October 1993, Vol 1, No 5, p 1.

Serim, Ferdi. *What the Blues Have to do with Paying Dues — Bringing Teachers OnLine*. Herndon, VA. NetTEACH NEWS, Vol. 1, No. 6, p. 1 .

Harris, Judi. *Designing Internet-Infused Educational Activities*. (Upcoming ISTE publication, release 1994.)

Tel-Ed 93, *ISTE Conference Proceedings*, 1994.