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Networking for K-12 Education: The Federal Perspective

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NOTE: At the time of publication, the author Anu Vedantham was affiliated with the Department of Commerce. Currently, she is a staff member of the Penn Libraries of the University of Pennsylvania.

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"N**etworking for K-12 Education: The Federal Perspective"**
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Abstract

This article explains the need for quality educational technology in our schools, and notes the contributions of existing technology in improving education. It describes the potential that telecommunications network technology holds for revitalizing American education. It outlines the major federal programs that provide policy guidance and funding assistance for educational institutions to access and contribute to the evolving National Information Infrastructure (NII), and summarizes federal activities to date. In particular it describes the relevant experiences of the first year of the Telecommunications and Information Infrastructure Assistance Program (TIIAP) which is part of the National Telecommunications and Information Administration (NTIA) at the Department of Commerce. Contact information for all federal programs is provided as well.

Biographical Information

Anu Vedantham is a Program Officer in the TIIAP grant program. She completed her masters in Public Administration from the Woodrow Wilson School at Princeton University in June 1994. She has worked with non-profit organizations in India and in the United States. She was a telecommunications researcher at Bellcore, and has conducted environmental research at the Environmental Defense Fund. She holds masters and bachelors degrees in electrical engineering from the Massachusetts Institute of Technology.

Laura Breeden is the Director of TIIAP and Chief of the Infrastructure Division at NTIA. Prior to joining NTIA, she was Executive Director of the Federation of American Research Networks (FARNET). She has also held management positions in the Network Services Group at Bolt Beranek and Newman. Her publications include 51 Reasons: How we use the Internet and what it says about the Information Superhighway and Building Consensus, Building Models : A Networking Strategy for Change.

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Introduction

On January 11, 1994, Vice President Al Gore set the stage for a national commitment to improving education through technology. He put forth the vision of "a different kind of superhighway that can ... give every American young and old, the chance for the best education available to anyone, anywhere," and challenged communications industry leaders to "connect all of our classrooms, all of our libraries, and all of our hospitals and clinics by the year 2000" to the information superhighway.[1]

The Clinton-Gore Administration has made the effective integration of technology into education at all levels, from pre-school children to adult workers, a priority on the Washington agenda. The Administration has created several new programs and has expanded existing programs to contribute to the policy debate on educational technology and stimulate investment in projects.

This article describes the need for quality educational technology in our schools, and notes the contributions of existing technology in improving education. It describes the potential that telecommunications network technology holds for revitalizing American education. It outlines the major policies and programs that the Administration has enacted to help achieve Vice-President Gore's vision of a National Information Infrastructure (NII) that benefits all Americans, and summarizes federal activities to date. In particular it chronicles the experiences of the first year of the Telecommunications and Information Infrastructure Assistance Program (TIIAP), which is part of the National Telecommunications and Information Administration (NTIA) at the Department of Commerce. A list of organizations that can provide additional information is given as well.

The Challenge: Equipping American Schools for the Information Age

Today's schoolchildren are growing up in a world that is linked through a global web of communications networks. They live in a society that produces information at an ever more rapid rate. Physical distance poses fewer barriers to communication than before, while instant access to relevant information becomes more and more crucial. In order to be successful in our globalized information-based economy, Americans will need to learn new concepts and make complex choices throughout their lives.

Although advances in technology over the last few decades have transformed the workplace, the home and many other aspects of our lives, the American education system remains largely unchanged from a century ago. Most American classrooms still operate on a model that was designed to train workers for a factory-based economy. As the recent report of the Information Infrastructure Task Force Committee on Applications and Technology (IITF/CAT) explains, "The textbook remains the basic unit of instruction. Absorption of its contents tends to be the measure of educational success."[2] The skills that citizens of the next century will need most - locating, organizing, evaluating and applying complex information from multiple sources; working in collaborative teams; and communicating effectively with co-workers - will not be easily derived from traditional textbook-based instruction. The "chalk and talk" paradigm treats students as passive recipients of instruction rather than active participants in the learning process. In contrast, today's economy rewards people who participate actively in networks of

collaboration and mutual learning.

The isolation of classrooms and teachers from the outside world is an important contributing factor to the slow pace of educational innovation. While most professionals collaborate with colleagues and develop new skills on a daily basis, school teachers work largely in isolation from their peers.[3] Collaboration with researchers and policy analysts in fields relating to educational technology is not common. As one high-school teacher relates, "Teaching is a solitary profession... 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 understands what my concerns are or what my curriculum entails most of the time."[4] Isolation is particularly acute for teachers working in rural areas and teachers working in specialized fields, such as those who focus on teaching disabled or remedial students.

The Status Quo: Information Technology in Classrooms Today

Today, technology in classrooms is typically limited to video instruction and stand-alone personal computers; network-based applications are rare. Although a few schools have successfully created immersive high-technology learning environments for their students, most schools do not have adequate computer and telecommunications equipment to integrate information technologies into their curricula. As a result, computers are being used largely as electronic workbooks.

In 1993, America's public and private schools invested $2.1 billion in personal computer technology.[5] The cumulative investment in personal computers over the last two decades has been substantial. However, the installed base of computers in American elementary and secondary schools is largely obsolete for most network-based applications. Eighty percent of the installed base consists of older models, including 55% Apple IIs and 24% IBM PCs, XTs, ATs or similar machines with limited graphic and multimedia capabilities. The remaining twenty percent includes 10% Apple Macintoshes and 8% IBM-compatible 386 or 486-based machines.[6]

Passive instructional technology has been easier to incorporate into the classroom, perhaps because it does not require dramatic changes in structure and curricula. About half of the nation's school teachers use video materials in their classes, while 75% of American schools have cable television.[7]

Interactive computer networking, even through low-cost dialup telephone connections, lags far behind. A 1993 survey showed that only 4% of American teachers have a computer with a modem in their classrooms, although almost 40% have access to a modem somewhere in the school.

Educational technology is not evenly distributed across the nation's schools. A common, albeit incomplete, measure of the level of computer integration in schools is "computer density" - the number of computers per student. The top twenty percent of schools have nine times as many computers per student as do the bottom twenty percent. Large schools, urban schools, private and parochial schools, and schools with large numbers of Hispanic students have lower than average computer densities.

However, since the installed base of computers is largely obsolete, computer density does not accurately reflect the uses of educational technology. Computer density also cannot reflect the actual use of computers in a school, in part because many schools do not have the skilled personnel needed to set up, install or maintain useful applications.

Disparities in computer networking are also dramatic. Instructional networks are more common in the Northeast states, in suburban schools, in communities where the educational level of parents is above average, and in elementary schools receiving Chapter 1 support (a measure of poverty).[8] In contrast, video technologies such as distance learning equipment, VCRs and cable TV are more evenly distributed.[9]

The Track Record: Educational Technology Works

Meanwhile, evidence continues to mount that using computer technology in education is effective, both in improving student outcomes and in value for dollars invested. A 1993 survey concluded that courses that used computer networks increased student-teacher interaction and increased interaction among students. It also concluded that such networks increased interaction between teachers and lower-performing students, and did not decrease traditional forms of communication.[10]
A review of multimedia instruction found significant time and cost savings over conventional approaches, and also found improved achievement and a direct link between interactivity and effective learning. Another study found that the use of technology helped children with disabilities learn within standard classrooms, decreasing their isolation.[11]

New types of educational technology may also make new types of learning possible. For example, some technology applications are more effective than traditional instructional methods in building complex problem-solving capabilities for information synthesis and in improving writing quality.[12]

The Vision : Improving Education through Information Technology

Information and communications technologies hold the promise of meeting a wide range of educational needs, including:

X **Access to individualized, self-paced instruction**

Global networks such as the Internet offer a wealth of information that matches every interest and capability. Several emerging Internet services such as the world-wide web (WWW), gopher and similar searching tools provide users with an experience that is similar to the self-paced casual exploration possible in museums and treasure hunts.[13] The vast amounts of available information can be explored to different depths based on an individual's range of skills and interests, and these on-line resources are especially valuable for lifelong learning needs.

X **More equitable access to all types of educational resources**

Through the Internet and other networks, schools gain access to valuable educational resources

such as expert human tutors, scientific data, libraries, computer software and multimedia materials. Telecommunications networks can remove obstacles to access faced by rural students and by students in disadvantaged neighborhoods.

For example, the Science-by-Electronic-Mail program in West Virginia provides five rural high school classes with mentoring by professional scientists in an innovative program that enthralls students. A Federation of American Research Networks (FARNET) report notes, "In some schools, the students would purposely miss the bus home so they could stay and work on the system, and in others, the students would arrive at six in the morning to use the Internet."[14]

X **The construction of a collaborative learning environment**

Networking technologies enable new types of interaction among students and between students and teachers. Communication and information resources give students the opportunity to learn as well as to contribute to the learning of others. The FARNET report describes, "The student can take on all kinds of roles: explorer, world traveler, foreign correspondent, intelligence analyst, scientist, artist, musician, published author and respected commentator."[15] Current projects that integrate networking technology in schools reveal that students enjoy contributing their perspectives and knowledge, and that such interaction increases motivation and improves performance.

X **Improved access for disabled individuals**

The process of interacting with a global network of people can be especially thrilling for disabled individals. A blind high-school student from the state of Washington writes, "Getting Internet access was the best thing that ever happened to me. In a way, my computer has become my eyes to the world. I can read a newspaper, talk to people around the world, and get materials for class papers, unlike before when I had to depend on others to get the resources I needed."[16] Because most information on the Internet can be accessed in a text-based format, and because communication on the Internet often requires no face-to-face contact, it can help break down many traditional barriers facing disabled students and offer them a crucial level of independence.

X **Continuous professional development for teachers**

Teachers are perhaps the only professional workers today who do not have convenient access to a telephone during their workday. Connecting more schools, and more classrooms within each school, to global telecommunications networks and creating network-based programs for teacher interaction will considerably reduce the isolation of teachers from each other and from professionals in education-related fields.

X **Improved communication between home and school**

As the number of Americans using the NII grows, connections in schools will help keep parents in touch with their children's progress and will provide new channels of communication between parents and teachers. The remarks of students, teachers, and policy makers who have participated in early experiments with network technology illustrate the tremendous excitement that

surrounds the use of information infrastructure in education. Networks allow parents and other community members who would serve as role models and information sources to join the formal learning process.[17]

X **Greater administrative and educational efficiency**

Locally defined budget and regulatory constraints have limited the innovation possible in many schools. Luther Williams, head of the National Science Foundation's Education and Human Resources Directorate, argues convincingly that educational technology may prove to be a necessary component in revitalizing K-12 education, given current funding constraints, and given the impressive productivity gains possible through investments in technology.[18]

Educational Reform: The Need for Thoughtful Integration:

Luther Williams explains that, in order to succeed, educational reform "has to be a very dynamic, robust, risk-taking based enterprise."[19] We need to explore a wide variety of possible solutions aimed at different scales of reform, and suited for the very different sets of circumstances in schools across America. At the same time, we must not lose sight of the integrated planning needed at the local, state and national levels to ensure that useful models are shared and that the same lessons are not unnecessarily repeated in different places.

We must also note the caution against unthinking acceptance of technology offered by Linda Roberts, Special Assistant to the Secretary of Education for Educational Technology, "We have to be honest about the barriers because if we're not, we're setting ourselves up to fail again... We present a picture that's too rosy, that's too opportunistic, that simply conveys one more time the silver-bullet theory."[20]

Interested stakeholders in our educational system are coming to the consensus that holistic approaches are needed in order to achieve lasting reform. Beverly Hunter, researcher in the Education Department at Bolt, Beranek and Newman (BBN) Systems and Technologies, describes the consensus of a large group of decision-makers and practitioners at all levels of the educational system, saying, "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 [etc.]) without moving hand-in-hand with people and systems across the full spectrum of society and its 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, [etc.]."[21]

The Federal Role: Responsive Coordination

Expenditures on elementary and secondary education by both private and public institutions total about $270 billion per year.[22] With federal funds forming a very small share (around seven percent) of this investment, the federal government has three important responsibilities. The government facilitates private sector investment in infrastructure by creating incentives, removing barriers to investment, and developing visionary "benchmark" applications. The

government communicates a vision for the possibilities that the NII holds, and promotes access for all citizens.[23]

A wide array of federal programs, in several federal agencies, are contributing to the ongoing efforts to incorporate educational technology and to connect schools to global telecommunications networks. Broadly speaking, federal efforts can be divided into two categories: programs that provide policy guidance and programs that provide financial assistance or stimulate investment at other levels.

Federal Policy: Engaging in the Debate

The most important recent federal policy action concerning education is the *Goals 2000: Educate America Act*, passed by Congress and signed into law in March 1994. The Goals 2000 Act puts forth a national education vision and outlines eight specific goals. These are: school readiness for all children; an improved high school graduation rate; demonstrated competency in core subjects at graduation from various levels of schooling; strengthening of mathematics and science education; higher levels of adult literacy and lifelong learning; safe, disciplined and alcohol- and drug-free schools; increased parental participation in the education system; and lifelong teacher education and professional development. The Goals 2000 Act targets educational technology as a central and essential tool in achieving the eight goals listed above. The Department of Education has taken a leadership role in implementing Goals 2000 by infusing technology considerations in educational programs at all levels.

The *Information Infrastructure Task Force* (IITF) is an interagency coordinating body that has taken a lead role in creating a vision for the NII. The IITF has given priority to a revitalized education system. In particular the IITF's Committee on Applications and Technology has presented a blueprint for using the emerging NII to "enable education to become a lifelong enterprise for all Americans, integrating and substantially enhancing school, community, and workplace learning and providing opportunities accessible to all."[24] The IITF/CAT proposes that federal, state and local governments provide a needed "jump start" to educational applications through public-private partnerships and encouragement of private capital investments.

The *National Science and Technology Council's Committee on Education and Training* (NSTC/CET) addresses policy matters and research and development efforts that cut across federal agency boundaries. NSTC/CET provides a formal interagency coordination mechanism for research and development in education and training, for promotion of technology to enhance lifelong learning, and for achievement of excellence in science, mathematics and engineering education at all levels. The Committee identifies needs, minimizes duplication, and fosters collaboration among the federal agencies that are developing and promoting the use of technology in education. It also coordinates federal support for state and local uses of advanced technology in education. The Committee also ensures the interoperability of systems purchased with federal funds.

The *National Telecommunications and Information Administration* (NTIA) serves as the principal executive branch advisor to the President on telecommunications and information policy, and develops and presents these policies to Congress, the Federal Communications

Commission, and international bodies. NTIA devotes special attention to bringing the benefits of the NII to traditionally unserved and underserved groups, including the poor, minorities, women, rural Americans and disabled individuals.

The *National Information Infrastructure Advisory Council* (NIIAC) is a presidential advisory group convened in January 1994 by Secretary of Commerce Ronald H. Brown. The thirty-seven members of the NIIAC include representatives from K-12 and higher education, as well as industry, labor, academic institutions, non-profit organizations and state and local governments. The NIIAC has initiated three "mega-projects" which are: access to the NII; visions and goals driven by specific applications; and privacy, security and intellectual property. NIIAC has been addressing issues such as providing schools with access to the NII and fostering educational applications.

Federal Funding Programs: Providing Models

Numerous federal programs provide funds to assist efforts by public, private and non-profit organizations. The Department of Education, of course, directly targets educational institutions. In addition, several other federal agencies provide funds for educational institutions and for education-related projects as part of their overall mandate.

The Department of Education Programs

The U.S. Department of Education serves as the main agency for the incorporation of technology in education. The agency manages several programs that support distance learning and educational technology.

Three large programs promote general issues of educational technology in schools. The programs created by the *Elementary and Secondary Education Act* (ESEA) fund almost one-third of all the software and hardware that is primarily used for basic-skills instruction in schools. The Chapter 1 section of Title 1 of ESEA focusses on very poor schools, and plans to spend more than $6 billion in 1995. The *Eisenhower Professional Development* program targets teacher training; the Chapter 2 program supports the requisition of computer hardware and software. The *School to Work* program implemented by the Departments of Labor and Education focusses on the integration of classroom learning and workplace skills, and has a 1995 budget of $125 million.

With a budget of about $27 million, the *National Challenge Grants for Technology in Education* program will fund the development of curricula that integrate new technologies and promotes ongoing professional development for teachers, administrators and other school personnel.

The *Goals 2000* program provides funds for state-level planning including the integration of technologies into curricula. With a 1995 budget of more than $400 million, Goals 2000 promotes the vital role of state-level coordination that is needed to ensure that schools make the right technological choices and are able to connect to present and future networks easily. State plans can help define interoperability and coordination decisions in ways that individual school districts cannot.

Two smaller programs target increased investment in telecommunications networks in particular. Funding from the *Star Schools Program* has helped provide telecommunications equipment and programming to underserved students in rural and urban areas. As a result of this effort, the number of schools participating in live, interactive, instructional programs nearly doubles each year. The Star Schools Program also supports clearinghouses of information about distance learning. In 1995, the Star Schools program expects to make about $30 million available for grants.

Other programs in the Department of Education that address educational technology concerns include the *Public Library Construction and Technology Enhancement* program, the *Improving Access to Research Library Resources* program, the *Technology, Educational Media and Materials for Individuals with Disabilities* program, the *Small Business Innovation Program* and the *Even Start* program for preschools.

Other Federal Programs

Several other federal agencies fund education-related projects as part of their overall goals.

National Science Foundation

The National Science Foundation runs three important programs that contribute in particular to the use of technology in mathematics and science education. The *Applications of Advanced Technologies Program* provides grants to evaluate new educational applications of advanced technologies. The *Teacher Enhancement Program* seeks to improve the interdisciplinary knowledge of teachers who provide mathematics, science, and technology education. The *Networking Infrastructure for Education Program* (NIEP) provides grants to education organizations and state agencies to investigate the role of electronic networks in support of education reform.

Department of Energy

The Department of Energy (DOE) provides an array of educational programs and materials for students, teachers and the general public. In 1994, the DOE operated more than 800 math, science, and technology education programs serving more than 400,000 students and 30,000 teachers. In particular, the *Small Business Innovation Research* program (SBIR) funds systemic studies and development towards meeting recognized needs in educational technology.

Department of Commerce

In 1994, its first year of existence, the *Telecommunications and Information Infrastructure Assistance Program* (TIIAP) awarded $24.4 million to public and non-profit institutions, including schools and universities. TIIAP funded 92 projects that use telecommunications capabilities in innovative ways for education, health care, public information, and other social services. For 1995, $64 million has been appropriated for the TIIAP program and related activities. Investment in telecommunications technology for K-12 education continues to be a

priority for the program.

The *Public Telecommunications Facilities Program* (PTFP) provides grants for the planning and purchase of telecommunications equipment to be used for educational or cultural purposes; in 1995 PTFP plans to disburse about $29 million. The *National Endowment for Children's Educational Television* (NECET) was created by the Children's Television Act of 1990 to fund the creation and production of television programming that is designed to foster fundamental intellectual skills in children, and has a 1995 budget of $2.5 million.

National Aeronautics and Space Administration (NASA)

NASA's *Information Infrastructure Technology and Applications* program (IITA) has been sponsoring pilot programs to improve science, mathematics, engineering and technology education through educational technology. The program aims to demonstrate technologies and techniques to facilitate educator to educator collaboration, to enable students to become electronic information explorers, and to provide teacher and student access to national information assets including real science data. The NASA IITA program includes eight NASA centers as well as an open solicitation program for *Education, Training and Life-long learning in Aeronautics*.

Department of Agriculture

The U.S. Department of Agriculture's Rural Electrification Administration provided $10 million in grants for distance learning, including classroom video facilities, and medical link projects in rural areas.

National Endowment for the Humanities

The National Endowment for the Humanities has an *Elementary and Secondary Education in the Humanities* program that is designed to improve teaching of the humanities in K-12 schools.

This list of programs is by no means complete. Each of the federal agencies mentioned above has other programs that also provide funds for educational technology.

The Telecommunications and Information Infrastructure Assistance Program (TIIAP): Experiences from the first year

A closer look at the experiences of the first year of the Telecommunications and Information Infrastructure Assistance Program (TIIAP) reveals several valuable models and concepts for an active federal role in supporting educational aspects of the National Information Infrastructure.

The first TIIAP grant round proved to be intensely competitive, with more than 1070 applications, that requested a total of over half a billion dollars, competing for 24.4 million dollars. The applications were evaluated by panels of experts and were judged on a range of criteria from equity concerns to interoperability to partnerships. Since the program required a minimum of 50% matching funds from almost all of the organizations receiving grants, the

process has generated a total of $67 million towards the broad-based development of the NII.

Projects targeted various sectors including community information, health care, government planning, education, libraries, economic development, and public information. About $2.7 million was awarded to 14 projects whose primary focus was K-12 education, and over two dozen additional projects targeted improvements in K-12 education as part of their objectives.

In order to leverage the limited funds available to TIIAP, the program focussed on funding projects that would serve as models for other communities across the nation. Funded projects used a range of technologies, from simple PC-based Internet access to advanced testing of two-way interactive video to practical applications of wireless communication.

Applicants were strongly urged to form partnerships with other organizations working in their geographic region or in their field of interest; this emphasis was intended to build links at the grassroots level that would be useful long after the grant period ended. The focus on partnerships was also designed to create and encourage conversations between organizations that may not have collaborated otherwise. Informal feedback indicates that the process of building these relationships has had many positive consequences even for applicants who did not receive awards.

Projects were evaluated on the degree of forethought to prepare against obsolescence, and on the degree to which they built on existing technologies and interconnections to existing networks.

The TIIAP program took the task of eliminating disparities of access and promoting equity seriously, and sought projects that reduced the gap between information "haves" and "have-nots". Evaluation criteria also included friendly user-interfaces, careful end-user training, and privacy concerns.

Highlights of 1994 TIIAP Projects in K-12 Education

The highlights of 1994 TIIAP awards for projects that work on K-12 education reflect the diversity and excellence of the applications received.

X The University of Maryland, in coordination with K-12 science and ecology programs, will develop a demonstration Internet Resource Center (IRC), K-12 access points, and linkage to the Chesapeake Bay Observing System (CBOS) for science and ecology information. The project will collect and process real-time environmental monitoring data from buoys suspended at different depths in the Chesapeake Bay, and make this data publicly available on the Internet. The University of Maryland will also work with K-12 schools in Maryland to create curricula and teaching materials that use the CBOS data to illustrate environmental and scientific concepts.

X Siskiyou County in Yreka, California will use a TIIAP grant to build a county-wide network, that connects 29 school districts using Integrated Services Digital Network (ISDN) technology. Pacific Bell is helping to build the network, which will provide Internet, audio-visual, library, and electronic mail services.

X The University of Alaska will integrate diverse networks, public broadcasting facilities, and the University's interactive television facilities. Through this project, schools in large areas of rural Alaska will be able to participate in distance learning and will have non-toll access to a network that combines educational, governmental, and library resources.

X Led by the Port Hueneme schools in California, three school districts, two in California and one in Georgia, will be connected together to test a national high quality video distribution system. The system includes distance instruction, teleconferencing, video on demand and delivery of interactive multimedia courses. If this technology proves successful, it may be a model for schools all over the nation for a low-bandwidth way of adding interactivity to traditional distance learning.

X The PUENTE Learning Center will create a distance learning link to improve its efforts with disadvantaged youth in East and South Central Los Angeles. PUENTE programs work to keep at-risk youth in school and provide free need-specific instruction.

X The Foundation for Educational Innovation, in partnership with Bell Atlantic, will take students in several inner-city schools in the District of Columbia on "virtual museum trips" using two-way video and teleconferencing technology. The participation of minority and at-risk students is a priority in this project. The new system will also be used by Howard University to provide teacher training.

X Six schools in the Harlem Economic Empowerment Zone will be able to access environmental resources and curricular material through graphical interfaces and connections to high-speed networks. The Harlem Environmental Access Project will be managed by Columbia University and the Environmental Defense Fund.

Several projects provide connections between schools and existing networks. The School District of Indian River County in Florida will expand their bulletin board system into a full community Internet gateway, and St. Joseph's School District in Missouri will construct a fiber-optic metropolitan network linking all district schools and their internal networks, providing Internet access as well as high-bandwidth CD-ROM based services.

The smallest TIIAP grant was a $3,000 award to Hall Elementary School District in Montana. The Hall school will connect to the Internet through a PC and modem, and bring access to the NII, as well as user training, to the students of their two-room school building and to the 95 residents of this rural town. The Quillayute Valley School District will connect tribal facilities and a rural Native American school in Washington to a state-wide network and the Internet.

The creativity and diversity of the applications received and of the funded projects was remarkable. The strong response to the TIIAP program from a wide range of organizations reveals the growing interest in and commitment to information technologies on the part of the non-profit and public communities.

Conclusions

Across the country, there is widespread interest in modernizing American schools to make them more effective for the Information Age. Technology - particularly computer and communications technology - has been shown to be a powerful tool for engaging all kinds of students in challenging instruction, meeting the nation's education goals, and improving access to the best educational resources.

Federal programs in educational technology and K-12 networking aim to stimulate and broaden the national policy debate on these issues, to encourage the rapid prototyping of new educational tools and materials, and to demonstrate models for widespread adoption of new technologies.

But the federal effort is only one part of the story. With 93% of funding for K-12 education coming from state and local sources, the most important decisions are being made locally -- by parents, teachers, principals, and school boards. Modernizing America's schools will require a partnership among federal, state, and local stakeholders. And the real drama will be played out in the classroom, where our children are preparing to become the citizens of the 21st century.

Acknowledgements

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Resources for Additional Information

Program Title	Address	Telephone
United States Department of Education		
National Challenge Grants for Technology in Education	600 Independence Ave NW, Washington DC 20202	(202) 401-1444 Julie Kaminkow
Star Schools Program	Office of Educational Research and Improvement 555 New Jersey Avenue NW, Washington DC 20208	(202) 219-2116 Cheryl Garnette
Public Library Construction and Technology Enhancement	Office of Educational Research and Improvement, 555 New Jersey Ave NW, Washington DC 20208	(202) 219-1303 Neal Kaske
Improving Access to Research Library Resources	Discretionary Library Programs Division Office of Educational Research and Improvement, 555 New Jersey Avenue NW, Washington DC 20208	(202) 219-1315 Louise Sutherland Acting Director
Technology, Educational Media, and Materials for Individuals with Disabilities	Office of Special Education and Rehabilitative Services, Division of Innovation and Development 330 C Street SW, Room 3525, Washington DC 20202	(202) 205-8106
Eisenhower Professional Development Program	Office of Educational Research and Improvement, 555 New Jersey Avenue NW, Washington DC 20208	(202) 219-2126 Charles Stalford
Small Business Innovation Program	Room 602D, 555 New Jersey Avenue NW, Washington DC 20208	(202) 219-2065 John Christensen
Even Start	Rm 4400, 600 Independence Avenue SW, Portals Building, Washington DC 20202	(202) 260-0996 Donna Campbell
School to Work	School to Work Opportunity Information Center 3040, 400 Maryland Ave SW, Washington DC 20202	(202) 260-7278
Goals 2000	Room 4000, 600 Independence Avenue SW, Portals Building, Washington DC 20202	(202) 401-0039
United States Department of Commerce		
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National Information Infrastructure Advisory Council (NIIAC)	Rm 4892, 14th and Constitution Ave NW Washington DC 20230	(202) 482-1835 Celia Nogales
Information Infrastructure Task Force (IITF)	Rm 4892, 14th and Constitution Ave NW Washington DC 20230	(202) 482-1835 Yvette Barrett
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Public Telecommunications Facilities Program (PTFP)	Room 4096, 14th and Constitution Ave NW Washington DC 20230	(202) 482-5802 Richard P. Harland
National Endowment for Children's Education Television (NECET)	Room 4096, 14th and Constitution Ave NW Washington DC 20230	(202) 482-5802 Heather Birnie
National Science Foundation		
Applications of Advanced Technology Program	4201 Wilson Blvd, Arlington, VA 22230	(703) 306-1651
Networking Infrastructure for Education Program	4201 Wilson Blvd, Arlington, VA 22230	(703) 306-1651 Email: nie@nsf.gov
Teacher Enhancement Program	4201 Wilson Blvd, Arlington, VA 22230	(703) 306-1650 Michael Haney
Other Agencies		
Information Infrastructure Technology and Applications program (IITA)	National Aeronautics and Space Administration 300 E Street NW, Washington DC 20546	(202) 358-4618 Paul Hunter
Rural Electrification Administration	U.S. Department of Agriculture, USDA-RUS, Room 2245-S, Washington DC 20250	(202) 720-0410 Joe Bender
Elementary and Secondary Education in the Humanities	National Endowment for the Humanities (NEH) 1100 Pennsylvania Avenue NW, Rm 302 Washington DC 20406	(202) 606-8377
Small Business Innovation Program	Office of Economic Impact and Diversity, Office of Small and Disadvantaged Business Utilization, ED-3, 905 H Street, Department of Energy 1000 Independence Ave SW, Washington DC 20585	(202) 254-5583
National Science and Technology Council's Committee on Education and Training	Office of Science and Technology Policy Executive Office of the President Washington DC 20500	202) 456-6100

Notes

1. Information Infrastructure Task Force Committee on Applications and Technology (IITF/CAT), "A Transformation of Learning: Use of the NII for Education and Lifelong Learning", in Putting the Information Infrastructure to Work: Report of the Information Infrastructure Task Force Committee on Applications and Technology, (Washington, DC: U.S. Govt. Printing Office), National Institute of Standards and Technology (NIST) Special Publication #857, U.S. Department of Commerce, May 1994, p. 57.
2. Ibid.
3. Ibid.
4. Nora H. Sabelli and Lida K. Barrett, Learning and Technology in the Future: A National Science Foundation Workshop Report -- October 4-6, 1993, (Washington, DC: National Science Foundation), Directorate for Education and Human Resources, October 1993, p.3.
5. Anderson, Computers in American Schools 1992: An Overview, p. 103 quoted in Wendy Lazarus and Laurie Lipper, America's Children and the Information Superhighway, (Santa Monica, CA: The Children's Partnership), 1994, p.11.
6. IITF/CAT, Op. Cit., p.65.
7. IITF/CAT, Op. Cit., p.57 and p.61.
8. IITF/CAT, Op. Cit., pp. 65-66.
9. IITF/CAT, Op. Cit., p.65.
10. IITF/CAT, Op. Cit., p.59.
11. IITF/CAT, Op. Cit., p.59.
12. IITF/CAT, Op. Cit., p.60
13. David D. Thornburg, Education in the Communication Age, (San Carlos, CA: The Thornburg Center), 1993, pp. 157-178.
14. Sabelli, Op. Cit., p.48.
15. Kathleen Rutkowski et al., Building Consensus / Building Models: A Networking Strategy for Change, Federation of American Research Networks, Inc. (FARNET) and Consortium for School Networking, March 1994, p. 10.
16. Sabelli, Op. Cit., p.50.
17. Rutkowski, Op. Cit., p.17.
18. Sabelli, Op. Cit., p.14.
19. Sabelli, Op. Cit., p.15.
20. Sabelli, Op. Cit., p.18.
21. Rutkowski, Op. Cit., p.33.
22. Lazarus, Op. Cit., Introduction.
23. IITF/CAT, Op. Cit., p.62.
24. IITF/CAT, Op. Cit., p.66.