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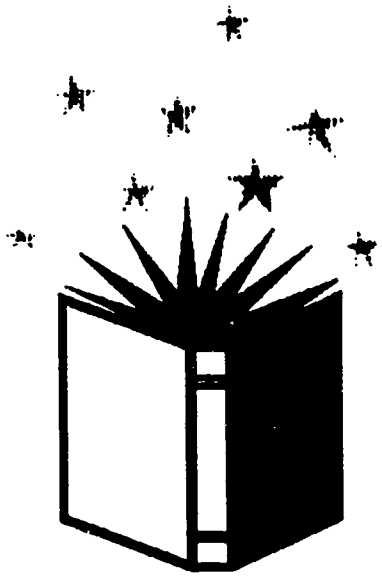
ABSTRACT

Telecomputing means using a computer that is connected to the Internet or an online service. Examples of how some students use this technology are presented. Illinois high school students design their own science experiments. At a middle school in New Jersey, home and school links and small group collaborative learning are enhanced through telecomputing. In Texas, a chemist helps students discover the causes of poor quality air in their middle school. Foreign language students Pennsylvania write messages in Spanish, French, and German for students in other countries. Blind students in Florida explore information resources and communicate with others in the community through a local bulletin board. Maryland students at a technical high school use the Sailor network to access statistics from the U.S. Department of Commerce to create career plans. Each project description includes contact information. The document also contains directions to the U.S. Department of Education Online Library. (SLD)

TELECOMPUTING FOR TEACHING AND LEARNING:

STORIES OF PEOPLE

USING COMPUTER NETWORKING FOR LEARNING



GOALS 2000
A WORLD-CLASS EDUCATION FOR EVERY CHILD

U.S. Department of Education
November 1994

Telecomputing. It means using a computer that is connected to the Internet or to an on-line service. For a growing number of teachers and students across the country, it means access to a world of information and people. The following examples offer a sampling of how some students are using this new technology.

In Illinois, high school students design their own science experiments. For example, they add and subtract ions to atoms and watch the results.

In Texas, a San Antonio chemist helps students discover the cause of poor-quality air in their middle school.

In Pennsylvania, foreign language students write messages in Spanish, French, and German to students in other countries.

In Florida, students who are blind explore information resources and communicate with people in the community through a local bulletin board.

In Maryland, students at a technical high school tap into statistics from the U.S. Department of Commerce to create career plans.

All these efforts have one thing in common: telecomputing. And behind each effort is a story.

You will find these stories on the pages that follow. They are stories of struggles and breakthroughs, successes and disappointments, hopes and promise. But most of all, they are stories about what real people are *doing* to put the power of computer networking into the hands of teachers and students.

You will find no sure-fire formulas or recipes. Where it is working, a telecomputing infrastructure is being built on the strengths and needs of the particular school and community.

Our hope is that, in reading these stories, you will find some clues about how you can harness the potential of telecomputing for your schools. We hope you will come away with ideas for developing your own answer to the question:

"What can my community and my schools do to make the promise of the Information Superhighway a reality for our children?"

These stories were created to accompany the October 18th GOALS 2000 Satellite Town Meeting, "Learning On-Line: Education and the Information Superhighway." They were written under the direction of Linda Roberts, Director, Office of Educational Technology, with assistance from the Office of the Under Secretary and Pelavin Research Institute. These stories, and eventually others, can be found in the "Technology" area of our Online Library.

DIRECTIONS TO THE U.S. DEPARTMENT OF EDUCATION ONLINE LIBRARY

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- Gopher and Mosaic/Lynx are the preferred access methods. Our FTP directories remain somewhat cryptic and the e-mail server is by its very nature a slow method to get documents.

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If you have any suggestions or questions about the contents of the WWW, Gopher, FTP, and Mail servers, please use one of the following addresses:

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gopheradm@inet.ed.gov
wwwadmin@inet.ed.gov

Telephone: (202) 219-1547
Fax: (202) 219-1817

Snail Mail: Inet Project Manager
U.S. Department of Education
Office of Educational Research and Improvement/EIRD
555 New Jersey Ave., N.W., Room 214
Washington, D.C. 20208-5725

CENTENNIAL HIGH SCHOOL

Centennial High School
Champaign, Illinois

- *Visual science experiments*
- *Multimedia research projects*
- *Writing projects*

It began with four science teachers and an idea: that computer networks could be a powerful tool for teaching and learning. They did not know how to finance additional equipment; nor did they see exactly how they would use networks in their classrooms. They knew they would need help, so they approached the National Center for Supercomputer Applications (NCSA).

EXPERT HELP AND ADVICE FROM A NEIGHBOR

NCSA is a federally funded research laboratory located in the Champaign-Urbana area. Although its primary function is to provide scientists with access to what can only be termed the "super-fast" computing power of their equipment (a Cray Supercomputer), the lab's official mission includes educational and outreach activities. It assists schools anywhere in writing grants to the National Science Foundation for funding of computer programs or for the acquisition of equipment. NCSA also organizes summer workshops for teachers and maintains an E-mail address for questions from educators regarding implementation of education programs involving computers, teacher training, and grant applications.

At NCSA, the science teachers from four high schools in the Champaign-Urbana area received assistance in writing a successful grant proposal to the National Science Foundation for a joint telecomputing project with NCSA. NCSA assigned the teachers a liaison, who worked with them on the implementation of the project.

The installation of computer equipment and network connections attracted the attention of Ameritech, the Great Lakes' regional Bell Telephone Company. The telephone company wanted to test some network equipment they hoped eventually to market. For that opportunity, Ameritech, through a grant to the University of Illinois, outfitted one of the public schools with high-density digital phone lines. Ameritech is now helping to build a community-wide network.

SCIENCE EXPERIMENTS ON THE COMPUTER SCREEN

The first telecomputing application at Centennial High School in Champaign connected the students of the Advanced Chemistry class with the supercomputer at NCSA. This was welcome news for Centennial, as some natural physical reactions, such as those inside molecules, can be modelled mathematically only with a complex and lengthy series of calculations. The supercomputer allowed students to design and conduct their own experiments and watch parts of molecules move on their computer screens, in response to their own computer commands. In one type of simulation, students watch the orbitals of models — their shape, number, or speed — in reaction to imposed actions. Another type of simulation demonstrates the ionization of atoms — how the size of atoms changes when ions are added or subtracted.

Such simulations of molecular behavior provide interactive learning rather than one-way presentation. Each student decides which atoms to use and what type of action to initiate. Since scientists developed the molecular simulation programs for their own research needs, whenever a Centennial High School student uses the program, he or she is imitating the behavior of scientists at work.

More recently, the NCSA has also written simulation programs in physics and mathematics.

Other Telecomputing Applications and Increased Use

The second telecomputing application at Centennial High School incorporates multimedia software (such as HyperCard and Mosaic), Gopher search software (Gopher finds files within libraries of files), and data bases from all over the world, containing text, pictures, and even music. A student conducting a research project on a Shakespearean play, for example, reads text from Henry V, views artists' renderings of the English king drawn in the king's time, and listens to music composed in Henry's era.

In the first year, 30 Advanced Chemistry students used computer network applications. Now, over 100 students in chemistry and other courses have access to the computer lab and use the networks for some school projects. Soon, students in *all* of the regular chemistry courses will use the supercomputer simulation programs over the network. Centennial High School also plans to connect to the network all of the Macintosh computers they use for their English courses, which start in the students' freshman year. (*All* students take the English courses.)

Still more students use the network before and after school to pursue their own interests and projects. The computer lab is open a few hours after regular class hours, and students can be found there until closing time.

As one grant tends to attract others, one successful telecomputing application attracts imitators. Telecomputing in the Champaign Public Schools now interests even the previously skeptical. It was natural that science teachers initiated the first telecomputing application. They had considerable experience with computers and understood their own capabilities as learning tools. Once they successfully implemented their telecomputing program, they were free to help other teachers do the same.

Glitches

Some teachers like telecomputing, particularly those who readily see its usefulness. Other teachers and some administrators believe money for telecomputing might better be spent on other programs. For the financial administrators especially, some of the added expense of telecomputing — that which is not covered by outside grants — is subtracted from their budget's bottom line, which makes them uncomfortable.

THE FUTURE

According to former science teacher Barry Rowe, the parents who voice an opinion on the telecomputing innovations are "universally enthusiastic about telecomputing." Some, in fact, worry that if their children do not learn telecomputing, they will be disadvantaged throughout their lives. In fact, it is often parents who provide the primary motivation for the adoption of telecomputing in a school. Schools get "wired for network connections" through parents' financial contributions or through parents' insistence that the school be wired. The Champaign Public School District is now in the process of integrating all its schools into a network.

The Champaign Public School District is now conducting a formal evaluation of their telecomputing programs, complete with objective outcome measures. Informally, though, the program has generated "great enthusiasm" among students and "much interest" among teachers and parents.

Barry Rowe,
Director of Educational Technology
Champaign Public Schools
(217) 351-3756 browe@ncsa.uiuc.edu

Lisa Bievenue
Centennial High School
(217) 351-3951

Scott Lathrop
NCSA
(217) 244-0072

PROJECT EXPLORE:
CHRISTOPHER COLUMBUS MIDDLE SCHOOL

Christopher Columbus Middle School
Union City, New Jersey

- *Schoolwide curriculum change*
- *Linking school and home*
- *Small group collaborative learning*
- *International correspondence*

The Union City school district was on the verge of being taken over by the state. This densely populated, poor, urban, Latino school district with 60,000 residents packed within one square mile had difficulty meeting New Jersey State education goals. Student attendance and scores on standardized tests were below state averages, while dropout and transfer rates were far above the state norm.

All that began to change in the 1989-90 school year. A new district superintendent and a new executive director for academic programs were appointed, and, because of the district's poor academic track record, the state required Union City to develop a five-year restructuring plan. As a result, teachers developed a new interdisciplinary curriculum for grades K-8 that emphasized research, learning by doing, cooperative learning, and the reading of challenging literature.

Other reform activities included changes in class schedules, with (a) extended block periods in communication and math and science, (b) the elimination of pull-out programs, and (c) more emphasis on staff development. With additional money from New Jersey's Quality of Education Act, the district made a significant investment in technology resources. In the last four years, for example, 775 computers were installed.

At the same time district reforms were taking place, the school district extended feelers to business and industry in New Jersey, hoping to convince those communities to invest resources in the schools. Initially there were no takers. However, Bell Atlantic — looking to test a communications system in an inner city, minority school district with a dense population — spotted the district's call for investment and decided that Union City was a match. The school district was renovating an old parochial school it had recently purchased to house seventh and eighth graders from two elementary schools that were overcrowded. During renovations, a state-of-the-art networking infrastructure could easily be installed, and in 1992, Bell Atlantic approached the school district and offered to implement a technology trial. It was an offer the district could not refuse.

WIRING UP

While the two-year project at Christopher Columbus Middle School began in September of 1993, planning had been underway for about a year. In the summer of 1993, Bell Atlantic installed in the school and homes of all seventh grade students and their teachers 486-level computers equipped with graphics and voice capabilities. The computers are tied into a local area network that is itself connected to a wide area network so that users can communicate between school and home and have basic software tools to carry out curriculum activities.

Students and teachers are encouraged to keep the computers over the summer; and the computers supplied by Bell Atlantic now supplement the ones already purchased by the school district. In addition to each classroom having several computers, there are computers in the media resource room, the science laboratory, and the computer laboratory, all areas to which students have access. The media resource room and the computer lab also have a large collection of software programs; and the teacher's room, too, is equipped with computers.

TECHNOLOGY AND THE CURRICULUM

Administrators and teachers now see the technology as an integral part of the curriculum, as it fits in well with their emphasis on research, critical thinking, and cooperative learning. For example, when students study the American Revolution, the teacher has them conduct research that they later share with the class. The teacher also can divide the class into research teams. One or two teams may conduct their research through traditional information, such as textbooks; another team goes to the media center and researches the topic on the Grolier multimedia encyclopedia; a third team uses the computer to research the topic through a CD ROM information disc; and a fourth group uses E-mail to access other forums or groups that may have information on the Revolution.

In their communications class, students can choose a novel to read and research novels written about bravery and the Revolution. In math, they can make pie and bar graphs to compare, say, British and American resources available during the Revolution. Teams that do not complete their work during class time can continue working at home and communicate with one another through E-mail. Student teams then write group reports on the computer, which they present to the class to establish "class knowledge."

SUPPORT IS THE CRITICAL FACTOR

One sometimes hears that teachers fear technology, but not at Christopher Columbus Middle School. Teachers at the new school had volunteered for the assignment. Their enthusiasm was supported by training they received from Bell Atlantic and from the Education Development Center's Center for Children and Technology.

Before the school year began, teachers learned computer basics and how to plug in multimedia applications to the new Union City seventh and eighth grade curriculums. They received training in how to manage files, use Microsoft Works and Microsoft Publisher, and generate applications using KidPix. Training continued through the school year, so that teachers learned how to use spreadsheets and database applications, E-mail, Lotus Notes, and Internet. The Center for Children and Technology also worked with teachers interested in discussing various technical and curricular issues that arose out of their work with Project Explore.

Teachers held two workshops to introduce parents to the new technology; and Bell Atlantic staff are currently in the process of setting up parent accounts on the network. The project had the support of the principal, who provided strong leadership and gave parents, students, and teachers an active voice in the decision-making process.

GLITCHES

Installing the technology is complex, and it is complicated by scheduling and coordinating the lines in students' homes and the school. Furthermore, it is more time consuming to maintain the computers and the network than Bell Atlantic initially anticipated.

Some teachers feel students might benefit from more software to help them develop and practice basic skills; others want bilingual software. Administrators want more educational tools to enhance the curriculum content. In Phase II of the project, beginning in September of 1994, a CD ROM library will be introduced to fulfill some of these desires.

Administrators raised some concern that the two-year length of this project may be too short a period for teachers to become comfortable with the new technology. Thinking about their students' future, administrators also are concerned that Christopher Columbus graduates, accustomed to working with technology, will be frustrated and constrained by the lack of resources they may discover at home and in their high schools.

THE FUTURE

Reforms initiated by the district have had a positive impact. Collaboration has become the norm among teachers, administrators, and parents using the network; and parents, teachers, and administrators are working toward establishing a school-improvement team.

When compared to national averages, Union City students in grades K-8 are "performing in the average to above average range in reading and language arts, and to the above average to best range in mathematics." On New Jersey's Early Warning Test, which measures eighth graders' knowledge and skills in reading, math, and writing, students in Union City are outperforming other urban and special needs districts in the state by approximately 10 percentage points.

In fact, on the practice Early Warning Test taken by seventh graders, students at Christopher Columbus had the highest overall scores of any students in the district. According to the Director of Academic Programs, these higher scores can be partially attributed to the amount of writing and editing that students are doing on the computers at the school and at home. Christopher Columbus also holds the district's best attendance record for both students and faculty.

While the transfer rate in the district has declined overall, it dropped significantly at Christopher Columbus. Students are using the media resource room during lunch time and after school. They're actually *eager* to hand in their homework, neatly typed on the computer. And they're lining up before the formal school day begins so that they can get into the building eager to continue their learning activities.

Contacts

John Grady
Bell Atlantic Video Services
(703) 708-4180

Fred Carrigg
Executive Director of Academic Programs:
Union City School District
Union City, New Jersey
(201) 348-5671

Margaret Honey
Education Development Center
Center for Children and Technology
96 Morton Street
New York, New York 10014
(212) 807-4209 mhoney@confer.edu.org

Pease Middle School
San Antonio, Texas

- *Scientist mentoring*
- *Student collaborative research projects*
- *International correspondence*

The quality of air at school seemed poor, so when students at Pease Middle School were asked to select a "study site," as part of their involvement in the Global Laboratory project, they and their teacher chose their own classroom.

Armed with an air pump, air testing tubes, and other tools, students conducted a series of tests. They found no appreciable sulfur dioxide, ozone, or carbon monoxide levels in their classroom; however, carbon dioxide levels consistently exceeded the recommended limit of 1000 parts per million set by ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers).

Mindful of complaints about poor air quality throughout the school, the students conducted a broad survey of air quality and sought the opinions of the faculty. Equipped with their air testing tools provided by the Global Laboratory project -- and following strict scientific protocols -- students measured CO_2 levels in other classrooms and found them also unacceptably high.

The class's CO_2 measurements and survey results were presented to the school board, which dispatched four environmental control officers to investigate. Linda Maston, a teacher and three-year veteran of Global Lab, used the computer network to report what ensued. She said:

> *"They [the officers] first went into the counseling office where the counselors and teachers told them about what was going on. They were not impressed, so they were brought to our classroom. As soon as we pulled out the data and the graphs showing the patterns that we had found, they suddenly started to take notes."*

The officers decided to make readings with their professional equipment. Ms. Maston continued:

> *"The moment of glory came this afternoon when they showed up with the same kind of tubes we had, and their fancy pump got exactly the same reading as we had with our syringe version!"*

Soon, the school's ventilation system was repaired. Not only had the students conducted real scientific research, their findings had made a difference in their environment. Linda Maston concluded:

> *"The CO_2 study was [the students'] pride and joy. They were just so pleased and proud of themselves that they had managed to do what nobody else had been able to accomplish in 17 years. To have their data taken seriously by adults in general, and the district in particular, was just awesome for them. They are so used to failure that it's hard to convince them sometimes that they're doing good work."*

TELECOMMUNICATIONS

After the Pease class made its school-wide CO_2 readings, the students posted a request on the Global Lab network for CO_2 readings in other classrooms.

From their colleagues in Aiken, South Carolina, the students received the following message:

> *"Hello San Antonio: We read your report about carbon dioxide and have a similar case here in Aiken, South Carolina. All of our classrooms have windows but we did a project which tried to test the carbon dioxide levels in the trailers where a lot of our classes are. Dr. Borst thought that they would have higher levels. Not!! The regular classrooms had higher levels... We explained this by the hallways."*
>
> *"Regular classrooms open into hallways, while the trailers open into the outdoors... So when the class changes you get fresh air in the trailers. In the regular classroom you get stale air from the hall. (Kennedy Middle School, Aiken, South Carolina)"*

SCIENTISTS ON-LINE

When Global Lab posted on several telecommunications networks a call for on-line scientists to support research on air quality in schools, Ken Muzal -- who works with real air quality measurements, industrial hygiene chemistry, and analytical chemistry -- offered to join.

In his e-mail message, Ken outlined the vital air quality issues on which students could focus their research. Students had already concluded that high CO_2 levels were the cause of the poor air at Pease. But after exchanging e-mail messages with Ken -- and while looking at "the nature of our school, how it was built, and the pattern of CO_2, levels that we had observed" -- students discovered the cause of the problem: inadequate ventilation.

GLOBAL LAB

The experience of this Global Lab class is not unique. Rather, it illustrates the kinds of activities occurring worldwide in classrooms participating in the Global Laboratory, a worldwide environmental project that fosters collaborative student research. By relying on an integrated use of several computer software programs and laboratory equipment, the project introduces classrooms to real-world investigations, technologies, communications, and collaboration — all of which supports student-based research.

Global Lab is administered by TERC, a 30-year-old nonprofit research organization devoted to improving math and science instruction in elementary and secondary schools. With a grant from the National Science Foundation, TERC provides a way for schools to participate in a *worldwide community* of student scientists investigating environmental issues. Global Lab schools also receive a collection (on CD-ROM) of curriculum, software tools, technical information; conferencing facilities to enhance collaboration with other schools around the world; and "starter kits" of materials to begin project-based explorations.

THE FUTURE

More than curriculum and technologies, the Global Laboratory is a community of students, teachers, and scientists engaged in real world, hands-on, interdisciplinary research. Unlike traditional curriculum, the project is dynamic and ongoing. In the 1993-94 school year, Global Lab students are building on the databases organized during the 1992-93 school year. These students will then establish new environmental monitoring sites at which future generations will learn and practice the diverse skills of true science.[1]

Peggy Kapisovsky, Communications Director
TERC
(617) 547-0430 Internet: Peggy_Kapisovsky@terc.edu

Boris Berenfeld, Co-Director
Global Lab
TERC
(617) 547-0430 Internet: Boris_Berenfeld@terc.edu

Stephen Bannasch, Co-Director
Global Lab
TERC
(617) 547-0430 Internet: Stephen_Bannasch@terc.edu

[1]This case study is adapted from an article written by Dr. Boris Berenfeld for the TERC publication, *Hands On!* (Fall 1993, Volume 16, No. 2). Dr. Boris Berenfeld is co-director of the Global Laboratory project.

Pittsburgh Public Schools
Pittsburgh, Pennsylvania

- *International correspondence*
- *Scientist mentors*
- *Teacher help line*
- *Research project collaboration*

During a demonstration at the University of Pittsburgh, teacher Mario Zinga saw the promise of computer technology. He and several other teachers who had seen the demonstration arranged a meeting between the Assistant Superintendent and Dr. Robert Carlitz, the demonstrator from the University of Pittsburgh -- and Common Knowledge was born.

Initially, four schools participated in the project in 1993 — two high schools and two elementary schools. These schools jumped on board because teachers or supervisors were enthusiastic about the project. In 1994, seven more schools — two high schools, one middle school, and four elementary schools — were selected through a competition for second-year sites.

Every school participating in the project has a local area network (LAN) and access to a wide area network and Internet. Three of the schools are wired throughout. At other schools, classrooms participating in the project are wired. In addition, all libraries in the schools are wired, so that students not participating in the project have the opportunity to use the network.

SCHOOL FOCUS AREAS

In one of the participating high schools, Schenley High School, the focus of the project is on foreign languages. Students use Internet to communicate in German, French, and Spanish with their pen pals in foreign countries.

At Westinghouse High School, where math and science are the focus, students conduct science research through Internet. The project at the school, developed in partnership with the Westinghouse Corporation, was designed to provide students with mentors from Westinghouse Corporation and university professors, to assist them with their research projects. Students communicate through e-mail with their mentors and use the online resources available through Internet. At the completion of their research on such topics as acid rain, oil recovery and chromium, students publish their own papers, using the school-based resources. For them, it is rewarding to see the fruits of their labors placed on the network. In addition, recognizing that it takes time to get up to speed with new technology, the project developed an internal mentoring process whereby seniors work with sophomores and juniors to help them learn how to use the necessary tools to use the resources provided on Internet.

At the elementary school level, the focus is on contacting other individuals to contribute to a project, rather than on collecting data. In the first year, teachers joined mailing lists for online projects already in existence, and in the second year, teachers are trying to initiate activities and develop their own collaborations on such topics as the river and the weather.

PROVIDING SUPPORT

Teachers participating in the program receive both educational and technical support. The project team trains teachers and has catalogued resources on the Internet to help teachers locate information on specific curriculum topics. In other words, the menu is determined by teachers' requests, rather than by some centralized group deciding what teachers should have.

The project team also helps students to use the tools on the network and set up network accounts. The ultimate goal is to help schools build their own expertise and give schools independence from the center. One way this has been tried is to use the network itself as a support system. For example, teachers are given an e-mail address named TROUBLE, where they can send a message describing the problems they encounter. A team of educators, technicians, and district personnel monitors the messages, and helps teachers solve problems.

To get additional schools involved, the project team provides introductory courses that demonstrate the usefulness of the technology and how to establish the network in the classroom. To encourage more schools to compete for a grant in the coming year, the project team will help schools who request assistance to write a proposal for funding under this grant and help them articulate the school team's visions for a particular curriculum area.

GLITCHES

There have, of course, been some glitches along the way. For example, some school administrators suggested that the internal competitive process for awarding grants may not be equitable. Some schools that have few resources feel they should automatically be awarded a grant. Still others feel that the selection process should be less competitive, so as to prevent schools from becoming losers.

The project aims to make the technology and resources of the Internet an essential part of instructional and administrative work at the Pittsburgh Public Schools. But, some district administrative staff members are concerned that they have not participated closely enough in the implementation process. Some district staff remain afraid of technological change and worried about how the project will affect them. Others are concerned about spending finite district resources on such new technology.

Although many teachers are ready for change, some fear technology or are unwilling to experiment with the network. Another issue that emerged among teachers is how to organize the classroom. The traditional 40-minute class periods, textbooks, and standardized tests do not easily accommodate the problem-solving, research-oriented thrust provided through the project. Alternatives must be explored.

THE FUTURE

The school district is in the process of developing a five-year technology plan that will tie in the technology to the major priorities of the school district and link technology with standards set by the state. In concrete terms, three schools will be added to the project by 1995, and it is hoped that by 1997, a total of 32 schools will have access to Internet.

Contacts

Robert D. Carlitz
University of Pittsburgh
316 Allen Hall
3941 O'Hara Street
Pittsburgh, PA 15260
(412) 624-9027

Mario Zinga
Common Knowledge: Pittsburgh
501 Fortleth Street
Pittsburgh, PA 15224
(412) 622-5930

Gail Futoran
University of Pittsburgh
Learning Research and Development Center
3939 O'Hara Street
Pittsburgh, PA 15260
(412) 624-7473

FLORIDA SCHOOL FOR THE DEAF AND BLIND

Florida School for the Deaf and Blind
St. Augustine, Florida

- *Telecomputing adaptations for those who are blind*
- *Telecomputing adaptations for those who are deaf*

"Training teachers to use computer technology is the cornerstone of the Florida School for the Deaf and Blind's technology program," says John Mark Leach, Coordinator of Computer Resources.

Teachers using computers in their classrooms take 40 hours of inservice training in their first year and 20 hours in their second year. The school contracts with experienced individuals to conduct the training and also uses an expert mentor model, with more experienced teachers helping the less experienced. With a faculty of approximately 130 teachers, over 90 percent have participated in technology inservice programs.

Computers were introduced in 1983 in this K-12 residential school, which serves approximately 610 students who are blind, deaf, or have special needs. For all of these students, computer technology is used in various ways. For those who are blind, for example, it is used primarily as a means of extending communication. For students who are deaf, it is used as a springboard to build concepts for written language. For students with special needs other than blindness or deafness, it is used more for instruction (such as review of basic skills) and language development.

All equipment used in the school is purchased through special funds. As a state institution, the school has received grants from the state legislature to purchase equipment; and over the last eight years, the school received two grants from Apple Computer to purchase equipment and to conduct training. In addition, a private foundation supports the purchase of some of the equipment.

The school is now in the process of being retrofitted to handle new technology. The institute received one $200,000 grant from the state to retrofit four of the major buildings; and recently they applied for a second grant. Since the school is made up of a complex of buildings, it will take some time to wire the entire institution. However, this year, almost every classroom has at least one computer. The school also has equipped two language arts classrooms (one in the deaf high school and one in the blind high school) with at least six networked computers for total integration of technology throughout its curriculum. In addition, each classroom has a modem with access to the FIRN (Florida Information Research Network) and, of course, the Internet.

BLIND AND LOW-VISION POPULATION

When computers were introduced to students who are blind, staff began experimenting with word processing capabilities. Within a short time, they realized that computers provided a way for students who are blind to break out of their isolation and communicate with people in the community to whom they would not otherwise have access.

In first grade, students who are blind are introduced to basic keyboarding skills. Usually by third grade, they begin learning how to use software to telecommunicate. They start by learning how to communicate with one another, then branch out to a local bulletin board within the community, which enables them to "talk" with other people outside the school. (One student developed such good contacts in the community that it led to a job upon graduation.)

By the end of middle school, students become relatively fluent in the use of the network and can download files; and as experience with telecommunication increases, students begin using the Florida Information Research Network, which gives them Internet access.

Students can take the computers home on weekends and, if parents are willing to accept responsibility for the equipment, they can take the equipment home with them over the summer. Staff noted that as more computers are going into the homes, parents are becoming more involved and often call the school to request help in deciding what type of equipment to purchase for their children.

Telecommunications opens unseen doors for those who are totally blind. There is a world of information available to them through computers with voice synthesizers and braille impact printers. As expected, the ability to have current information literally at their fingertips has helped students who are blind become more productive. As John Mark Leach noted, "An assignment that used to take students three weeks, because they had to wait for some transcribed information, can now be finished in *three days*."

While technology for those who are totally blind focuses primarily on facilitating communication, for students with low vision, the technology is used for both telecommunications and computer-assisted instruction. Students can use off-the-shelf instructional programs with large-print monitors and printers.

DEAF POPULATION

Students who are deaf use technology to develop language skills. These students tend to have trouble processing written language, but, through the use of animation, video, and other software, students and teachers work cooperatively to enter new worlds of expression.

The school is integrating technology into the curriculum as well as building on students' own experiences. For example, high school students, some of whom escaped from Cuba, are building a hypermedia presentation of life in Cuba. Through a cooperative effort, students who are deaf are planning, developing, and producing a multi-media expression of their experiences to share with others.

A recent grant from Apple Computers is being used to develop a curriculum that focuses on the theme of Deaf Culture. This curriculum will give children who are deaf the opportunity to explore the richness and diversity of their own culture, and will encourage a sense of pride as well as improve their language and writing skills — all through telecommunications.

GLITCHES

Lack of sufficient resources is a problem. Not enough computers are available and some teachers lack telephone lines to connect to the Internet.

More specifically, it is difficult to get the peripheral and software equipment needed by those who are blind. Since the market is relatively small, not enough profit motive exists to drive the development of new software. The change in technology from MS DOS to Windows also hinders accessibility for students who are blind.

THE FUTURE

Students are turned on to learning through the use of computers and are disappointed when technology is not available. For example, some middle school students were disappointed when they moved on to high schools where computers were not available. Yet, everyone seems to be looking forward to having all the school buildings retrofitted. Once completed, it will be the norm for students who are deaf and blind to share files easily and chat with one another. The school also will continue to ensure that all teachers interested in using computers receive adequate training, making the future for this experiment look bright.

John Mark Leach
Florida School for the Deaf and Blind
St Augustine Florida
(904) 823-4461

MARYLAND SAILOR
LIBRARY INTERNET CONNECTION

Maryland Sailor
State of Maryland

- *Round-the-clock public access to public libraries*
- *Internet access for all schools*
- *Inservice training for library media specialists, teachers, and public and academic librarians*

Anyone living in Maryland can board Sailor and take an electronic cruise, thanks to a project launched by Maryland's library community to provide free Internet access to state residents.

It began two years ago with 15 librarians and technicians who were interested in sharing library resources more effectively. They developed a plan to connect the state's libraries for resource sharing and Internet access. Interest spread and some 125 people from the library community became involved in all aspects of the project, from marketing and grants development to training and assessment. Included in the initial group was a library automation specialist from the University of Maryland, who brought the idea to computer experts at the university. The institution agreed to extend its telecommunication system to the library community and offered to pilot the *Sailor Gopher*. The university continues to provide encouragement and technical support, including a helpline, for Maryland educators.

The University of Maryland operates a bulletin board, "K-12 Community Listserv," and a discussion forum that gives educators an opportunity to learn from one another. E-mail accounts are available, free of charge, to interested educators so that teachers can connect to other computers and see the kinds of information sources they have available.

Enoch Pratt Free Public Library was the first library to offer Sailor. From July 27, when the system first went public, to August 8, Pratt library received 90,253 calls to access Sailor. The average number of simultaneous users at any given moment was 45. When a staff member checked usage at 3 a.m. on August 1, she found 12 electronic customers at work. "Quite an extension of normal public library hours," she observed.

For a modest fee ($100 a year), people can obtain accounts that will give them access to additional Internet services.

IMPACT ON SCHOOLS

Schools facing budget cuts are likely to benefit from Sailor. The connection with Internet provides students and teachers with a wealth of up-to-date information, such as scientific databases, economic forecasts, and newspapers and journal articles.

Library media specialists and teachers throughout the state use the telecommunication system in a variety of ways. At one elementary school, for example, students are working on a joint classroom project that connects the children to databases that review books. The project involves the purchase of new books for the school library. Working with a budget of $100, students research and make a collective decision on the selection of books. The decision making process involves consulting

reviews from children's literature databases, learning how to evaluate materials and information sources, and developing criteria for book selection. As they work through the process, students learn how to plug into information.

Another elementary school is linking students to a worldwide collaborative called KIDLINK. The project they are working on is "A Day in the Life of ...." Each day students record their activities and share their experiences across the network. What they are learning is that kids are more alike than different regardless of where they live.

At Eastern Technical High School in Baltimore County, Sailor is used with a variety of classes, including math, chemistry, engineering, allied health, and nursing and English. In the English class, students use Department of Commerce economic statistics to develop a realistic career plan. The students scan the *Occupational Outlook Handbook*, research various trades, and review current employment rates and employment projections in different job areas, in different parts of the country. Such activities help students to understand the job market better and to make more informed choices about possible careers. Students also come to the library media center on their own. Many students in this economically diverse community do not have a modem at home, so they use the equipment before or after school, or during their lunch break.

EMPHASIS ON TRAINING

To acquaint them with Sailor's potential, the State Division of Library Development and Services provides awareness training for library media specialists and public and academic librarians. This awareness training has generated a grass roots movement among trainees and fostered use of the network. In addition, media specialists are forming their own user groups to share ways in which they are using the telecommunications network; and some local education agencies are providing school staff with computer and telecommunications training.

In Baltimore County, the Office of Library and Information Technology received a $55,000 grant from the U.S. Department of Education's Office of Educational Research and Improvement - Library Programs to train library media specialists and public librarians on how to use electronic media sources and telecommunications. The grant, which began in January 1994, provided funds to set up a training site at Eastern Technical High School, including the installation of 11 modems and phone lines in the library media center.

Because inservice training is provided for teachers, they are experimenting with using computer menus to narrow down the information they are searching for. In addition, supervisors, coordinators, and district-level administrators are learning how to use Internet; and administrators have started their own Internet users group.

Nancy Null, a library media specialist at Eastern Technical High School, uses the equipment to train students at the school. Students work in collaborative groups at the library computer stations and learn how to access data through telecommunications.' Once they become familiar with Sailor, the students tap various sources to learn more about their assignments and interests.

GLITCHES

There were a few initial problems. For example, the higher-speed ISDN telephone lines required for the network were at first not available in all parts of the state. As a result, the system took longer to install than initially anticipated.

At the school level, telephone lines in the library media center did not exist, and getting the budget and installing the phone lines was difficult in some schools. In addition, not all library media specialists are comfortable with the new technology. As a result, they are more reluctant to use the network themselves or work with teachers and students to use the network. Finally, there are times when classes come to the library media center and cannot get online because there are not enough lines. The teacher and library media specialist have to change their lessons for the day quickly.

THE FUTURE

Since training is an essential ingredient in fostering the use of the network, the State Division of Library Development and Services is developing a plan to train master library media specialists and public librarians. Two training sessions are scheduled (one in December and one in January) for a total of 40 individuals. The objective of the training plan is to have individuals serve as trainers for other librarians and media specialists in their own regions so that training will be provided throughout the state.

One of the goals of the state library division is to have Sailor recognized as "Maryland's public information network." By offering network accounts through local public libraries on a cost recovery basis, the state is hoping to give any individual access to a wide range of state and local information. At the school level, a future goal is to find an economical way to link all of the schools to Internet.

Sailor's implementation through September 1995 relies on Federal Library Services and Construction Act funds. Efforts are under way to receive state funding for Sailor's ongoing costs beginning in July 1995.

Nancy Null
Eastern Technical High School
Baltimore County, Maryland
(410) 887-0210 nnull@umd5.umd.edu