The Concord Consortium
Realizing the educational promise of technology Spring 1999
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INSIDE

VHS ISSUE INSIDE

Free and Open to All

The Potential for Free Open Source Software in Education

by Robert Tinker

Does free software that improves technology-based learning and saves billions of dollars for education sound like an impossible dream? Thanks to a rapidly growing movement based on an operating system that many refer to as "GNU/Linux," realization of that dream may be closer than you think.

What are its advantages? The GNU/Linux[1] operating system is smaller, more reliable, more extensible, and faster than Windows NT, Windows 98, or the Macintosh OS. It offers capabilities that Apple and Microsoft have only promised to deliver. Fully half the Web servers on the Internet are running on the free software Apache, which is based on GNU/Linux. And programmers working cooperatively over the Internet all over the world have developed many other packages of free software as well.

One group refers to this kind of software as Open Source, but the originator of the movement Richard Stallman prefers the term Free Software. To be inclusive, we use the name Free Open Source Software (FOSS) to refer to software with source code that can be modified and freely redistributed. Programs whose source code is available to users – for modification, improvement, or just plain curiosity – and which is free of charge would clearly benefit the education sector.

Recent Developments

Public acceptance and enthusiasm for GNU/Linux is on the upswing. In the last few months, GNU/Linux has been featured in *The New York Times* newspaper and magazine, *Forbes*, *Scientific American* and on National Public Radio. In February, protesters who use FOSS operating systems rallied at Microsoft offices demanding a refund

(continued on page 4)

[1]GNU/Linux is a term that refers to the work done by GNU (Ga-new), a project organized in 1980s by Richard Stallman that made operating system components that extended the UNIX operating kernel and an alternative free kernel called Linux (LINN-ex) developed in 1991 by Linus Torvalds. The resulting GNU/Linux combination is popularly known as the Linux operating system. We choose to call it GNU/Linux, although we acknowledge that others have differing views.

LINKS ON THIS PAGE
GNU/Linux—www.gnu.org
Apache—www.apache.org
National Public Radio—www.npr.org
Scientific American—www.sciam.com/1999/0399issue/0399cyber.html
New York Times—www.nytimes.com
Forbes—www.forbes.com

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Meet the Board

Our Board of Directors is a diverse association of dedicated and successful professionals committed to expanding educational opportunities worldwide. This issue of @CONCORD profiles the final two board members and their interests. More detailed information about each member is available from our web site.

Sheldon Berman is treasurer and a founding member of The Concord Consortium. Shelley is one of the founders of Educators for Social Responsibility, a grassroots educational membership organization that currently is focused on conflict resolution in education. Shelley is the superintendent of Hudson Public Schools in Hudson, Mass., which is a leader in instructional innovation. He is helping forge a productive relationship between his schools and our R&D. Shelley is the author of two books: *Promising Practices in Teaching Social Responsibility* (1993) and *Children's Social Consciousness* (1997), published by SUNY Press.

Tally Forbes is a founding member of The Concord Consortium. She is vice president of Earthwatch Institute, where she is in charge of education and development. Earthwatch is an international nonprofit organization which has provided opportunities for teachers and students to make important scientific contributions in field research by joining scientists at their field sites worldwide. Through Tally's efforts, these teachers are using technology to integrate their field experience into their teaching. Tally's continued involvement in the Board of Directors provides us expertise in fund raising, scientific research, and educational innovation.

We Dream . . .

We dream of an educational system that responds to each person's learning needs. We dream of classrooms where there is collaborative learning. We dream of students and experts working together locally and internationally to solve problems worldwide.

Education is the single most important investment a society can make in its future. Quality education is essential to help people everywhere realize their full potential. The Concord Consortium is a research and development nonprofit organization made up of teachers, curriculum developers, technology experts and innovators committed to stimulating large-scale, technology-based improvement in teaching and learning.

Through the creative and appropriate use of information technologies, we believe our dream of universal quality education is possible.

We are dedicated to realizing the educational promise of technology.

The Concord Consortium

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Earthwatch—www.earthwatch.org
Hudson Public Schools—www.hudson.k12.ma.us
Board of Directors—www.concord.org/about/board.html

Synergy Projects and Pocket Computers

Kids can use a pocket computer equipped with a probe to analyze air temperature.

by Carolyn Staudt and Sherry Hsi

Over the past several years many breakthroughs have occurred in learning technologies. Students are able to explore, investigate, and analyze their local environment with increasing ease. Teachers are using graphing calculators connected to computer-based lab interfaces to test the water quality in streams. Programmable motion detectors and light switches are being used to teach concepts of control and feedback. Due to technologically innovative and powerful tools, students are engaged in the inquiry process firsthand.

We've all seen the business traveller who boards a plane scribbling on a pocket computer to review a schedule, find a phone number, prepare a presentation or record expenses. Now imagine these small personal computers in the hands of every student. Not only could they take notes anywhere, they could calculate real life math problems, set up spreadsheets, organize databases, draw sketches, even collect data from their surroundings. As a result, a set of numbers and abstract science concepts becomes linked to relevant experiences and personal everyday events.

In partnership with the Center for Innovative Learning Technologies (CILT), The Concord Consortium is developing and studying educational uses of inexpensive computers and computer interfaces with students. Through the Low-cost Ubiquitous Computing Theme research efforts of CILT, students are testing the use of pocket-sized computers and portable probeware.

These small computers were originally conceived as electronic personal organizers. Probeware is software and hardware that allows sensors to be connected and used with these portable computers. From our experience, providing low-cost computers and universal access to all students will fundamentally change learning.

Our first experience with these amazingly friendly small computers was with a fifth grade class. We had asked the students to explore changes in distance over time using a recently developed lantern-style CC Smart Sonic Ranger. With the aid of software, data was displayed on a computer screen in graphical form so that the students could quickly analyze and explore motion.

We placed similar software on the 3COM Palm™ and one sunny afternoon asked two the fifth grade students to test the Palm and the Sonic Ranger in the school playground. One grabbed the Palm and the other took control of the Sonic Ranger. Together they walked from one end of the playground to other designing activities to plot out distance and recognize motion. Their immediate ownership of the pocket computer and probeware was a glimpse at the readiness students have to explore and design their own investigations.

The CILT Synergy Project is targeting this excitement on the part of the students for inquiry. It is also studying the role of teachers in supporting integrated science learning mediated by pocket computers. These early studies are pilots for larger studies planned in primary, middle, and high school classrooms this fall. Palm Computing, a 3COM company has donated pocket computers to begin these studies. A new Palm interface called ImagiLabs can be attached to Palms to allow data collection. CILT researchers will study how students use pocket computers coupled with ImagiLab to record and understand data.

Pocket computers initially will be testing with 10th grade students in California as field-based inquiry tools to complement an Internet-based curriculum and Internet-based student assessments. Students will use the Palm to study ecosystems and measure factors such as pH, dissolved oxygen, and salinity in a local creek. Using the data they collect at the creek, students will use Internet-based modeling and visualization tools to construct their understanding of water quality and determine how to create healthy water.

At the same time, the Kids and Palms™ project is initially testing pocket computers with students on the primary and middle school levels in Massachusetts. This project will design activities, curricular materials, and assessments with teachers to establish if the students in and out of the classroom can use these handy portable computers. Age appropriate activities with Palms are planned for students in a second and fifth grade. @

Carolyn Staudt is a curriculum developer for The Concord Consortium. Sherry Hsi is a post-doctoral scholar at the Center for Innovative Learning Technologies. Carolyn@concord.org, Sherry@concord.org

LINKS ON THIS PAGE

CC Smart Sonic Ranger—concord.org/slic/smartprobe.html
Synergy Project—www.concord.org/~sherry/cilt
3Com Palm—palmpilot.3com.com
CILT—www.cilt.org
ImagiLabs—www.imageworks.com

Free and Open to All

continued from page 1

on the unused copies of Windows that came pre-installed on their PCs.

Corporate and investor interest in GNU/Linux is growing, too. Not only has the publicity made GNU/Linux, and by extension all FOSS, more acceptable to the public, it has resulted in investment funding for companies such as Red Hat and VA Research that will lead to healthy competition in technical support services. GNU/Linux users will now have inexpensive options for technical support (though much support is also available via the virtual support circle of other GNU/Linux aficionados).

The acceptance of FOSS is important because it challenges the conventional wisdom that free software is unsupported, and therefore, useless. In fact, many of the most important elements of a FOSS system are supported and updated at a level far above that of commercial software. Greater acceptance could generate support for publishing educational software as FOSS. Educational funders often insist that projects generating educational software find a publisher to disseminate the software, even if they charge exorbitant prices. The well-founded fear is that by placing software in the public domain for free (otherwise known as "freeware"), no upgrades or ports would ever be made and the software would become obsolete as soon as the technology moves on. The fallacy in this argument is the assumption that making the software free and open source is equivalent to placing it in the public domain and providing it free. A key element usually incorporated into FOSS software licenses is that if modifications or improvements are made these changes must also be made available to the community under a FOSS license such as the GNU Public License (GPL)[2]. A FOSS license provides an alternative that ensures a continued life for the software. This subtle but crucial difference is the legal and ethical underpinning which helps create trust and cooperation among far-flung programmers. No one is afraid that their code will be ripped off for profit; in fact, often there is a healthy competition to see who can write the best code.

Until recently, FOSS has been associated with operating system software only, but this is changing rapidly. System software is just the beginning. In addition to the Netscape browser, there are now FOSS spreadsheets, word processors, a presentation package (similar to PowerPoint™), and Gimp, an image manipulation program that is similar to Photoshop™. There are thousands of applications being developed including some primitive educational tools.

Educational Uses

At the founding of The Concord Consortium over four years ago, we selected GNU/Linux as the operating system for our email, ftp and web hosting. It has proven to be stable, high performing, and easy to maintain.

The current educational value of GNU/Linux is limited, however. Because it is unlikely that many students and teachers would want to use raw GNU/Linux, its main application today is in back rooms where network servers live. While this might reduce the cost of software for these computers and improve their reliability, it would not represent a major savings for schools, who need relatively few servers and whose operating systems are a small expense compared to hardware, networking, and support costs.

But now that GNU/Linux is soon to have two graphical user interfaces (GUI) and extensive support, it could begin to have a major impact on education. The KDE and GNOME graphical user interfaces look similar to traditional desktop environments using a mouse to control moment and sizing of windows, for instance, conventions with which PC and Mac users alike are familiar. While impressive, GNOME is under development and not ready for

[2] The GPL requires that anyone can use the software without charge, provided any improvements made are protected with the GPL copyright.

Glossary of Terms

Free Open Source Software (FOSS) is our nondenominational attempt to clarify the *open source code* and *free* labels; it refers to programs that are both open source (you can see and modify the source code), freely available and sometimes free of charge.

GNOME is a graphical user interface – in other words, a desktop environment, being developed by the Free Software Foundation. **KDE** is a competing free desktop environment.

GNU (Gnu's Not Unix) is a free software system that is upwardly compatible with Unix.

Java is a programming language designed by Sun Microsystems for cross-platform functionality.

Linux is the kernel of an operating system developed as a variant of the UNIX operating system. Together with GNU, it is a reliable operating system, known as Linux-based GNU System or GNU/Linux.

LINKS ON THIS PAGE

GNU Public License—www.gnu.org/copyleft/gpl.html
Darwin—www.publicsource.apple.com/projects/darwin
VA Research—www.varesearch.com
GNOME—www.gnome.org
Gimp—www.gimp.org
KDE—www.kde.org
GNU/Linux—www.gnu.org
RedHat—www.redhat.com

general use. However, given the pace of development, we anticipate only months – not the usual years of software development – before a free stable graphical user interface is available.

When a good graphical user interface exists for powerful and reliable productivity and educational packages, the benefits to schools will become substantial. Because FOSS software can be freely distributed, a school that built its technology use around general-purpose FOSS tools and Java applications could make these tools available to everyone in the school community, including parents. For those running GNU/Linux, this would increase student and community access to technology while reducing school software and support costs.

It would also reduce the support costs associated with tracking licensed software and moving limited quantities between classrooms as needed. FOSS software could also reduce hardware costs because it is relatively compact and can run on older, perhaps donated, computers. Once free open source software matures, it will be quite stable, so its use might also reduce technical support costs. The combination of these factors could, in a few years, add up to significant savings for education, while offering better reliability and new educational benefits.

Commercial Software vs. FOSS?

Commercial educational software can exist along with FOSS, so education will be best served by a combination of FOSS and commercial software. The FOSS strategy works because a large community of programmers is willing to undertake software development and knowledgeable users contribute support. By not being proprietary, free open source software encourages elegant problem solving and local and international cooperation. Since many programmers get no financial return for their improvements, most contributed FOSS is created to solve real-world problems faced by programmers, e.g., a student needs a new function for a thesis or a company needs to support infrared ports.

Educational publishers, however, will continue to produce and support specialized educational software. They will simply add GNU/Linux to the operating systems they support. Already, Blackboard, a commercial online course authoring and delivery system, runs with GNU/Linux. Most educational software is now being written in Java because it is the best dual platform (i.e., Windows and Mac) development environment. Because there is a FOSS Java interpreter, all the present and future educational software written in Java will run with GNU/Linux, whether FOSS or commercial.

Other powerful educational applications like Logo, HyperCard, and probeware are likely to follow. A package of software modules that support student records, individualized assignments, and electronic portfolios could be generated in FOSS.

In essence, an educational strategy that relies on FOSS software should depend primarily on general-purpose tools. Because the number of tools is limited and the tools themselves are general, teachers can integrate them widely in the curriculum. From the perspectives of both educational reform and the cost of support, this is a sound educational strategy.

Next Steps

The time is now ripe to launch a research and development effort to bring the benefits of free open source software to education in a timely manner and to evaluate its impact. While FOSS may not yet be ready for large-scale implementation, it is almost certain to be there soon. It is important to have research results available at that time that can help guide educators and answer the inevitable questions about the cost and educational value of widespread use of FOSS in education. It may also be possible to stimulate the creation of a programmer group interested in creating and maintaining free open source software for education.

Three initiatives are needed. The first would create pilot implementations of FOSS to better understand the total costs and benefits of institution-wide use of this type of software. A second would support increased educational use of FOSS by harvesting the available free open source software and supporting its use in education. The third would stimulate the development of quality free software for education by engaging the programming community in creating needed software.

Initiative One: Create Pilot Implementations

A few ambitious colleges and school districts should be extensively supported in early and wide implementations of FOSS. Institutions serving poorer populations might benefit most from savings. The goal of these pilot projects would be to gain operational experience that would be widely useful.

Pilot studies are important because educational technology is intimately related to the intellectual and educational life of institutions. The shift to FOSS may involve corresponding shifts in the kinds of software promoted and the educational strategies used. Because there will be fewer compatible educational titles, educators will have to abandon software written before

(continued on page 6)

LINKS ON THIS PAGE
Blackboard—www.blackboard.com
Logo—lcs.www.media.mit.edu/groups/logo-foundation/Logo/Logo.html

Free and Open to All
continued from page 5

Java became the dual development platform of choice. This means a shift to educational use of FOSS general-purpose tools or software written in Java that might be commercial or free.

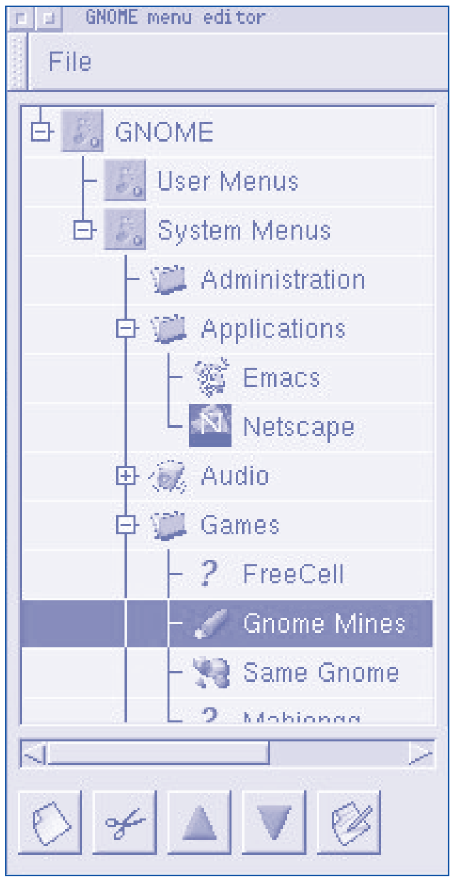
Such extensive change will be more of a liability at institutions already making sophisticated and varied use of educational technology than at poorer institutions just starting to use technology. Many effective school technology plans support the use of a limited number of software titles; schools can implement a few broadly and deeply rather than a greater number, but only for a shallow application.

Institutions pilot testing FOSS will need extensive technical support, teacher professional development, and tool-based curriculum materials. They will need to revise their plans for integrating technology into education around the strengths and weaknesses of FOSS. Their teachers will need assistance in creating activities that take advantage of general tools and the Java applications available. Their technical staff will need support to make the changes.

The pilots will need to be carefully observed and evaluated. To understand the actual savings, a thorough accounting will be needed to determine the full costs of traditional approaches and the pilot implementations.

**Initiative Two:
Increase Educational Use of FOSS**

There is a need to harvest the available free open source software and support its widespread use in education. This would involve providing tested and easily installed distributions of FOSS software of particular interest to educators. As the FOSS movement expands, there will be an increasing deluge of software of variable educational value and technical quality. Sifting through this for applications that are solid both educationally and technically will be beyond the capacity of most schools or colleges. A central operation is needed that can provide a combination of educational and technical guidance. The educational guidance would involve suggesting new programming projects and evaluating those under way. Technical guidance would ensure the quality and compatibility of the resulting code.



The graphical user interface being developed by GNOME is familiar to Macintosh users.

This technical service might also involve the creation of some new applications. For instance, being able to generate x-y graphs from a spreadsheet is very important in education. The available FOSS spreadsheets may not have any graphing capacity, but could be easily hooked into a FOSS grapher. An effort to collect and distribute educational FOSS should include hybrids like this when educational needs are recognized.

**Initiative Three:
Develop Quality Software**

The most speculative effort, but one with the biggest potential payoff, would involve attempting to enlist volunteers in the creation of educational FOSS software. If the same altruistic instincts that have led thousands of programmers to create GNU/Linux can be harnessed for education, there could be an avalanche of free educational software.

Rewards and a seeding effort might be all that is needed to unleash a software effort that would easily surpass all programming currently being done in education.Rewards might involve the recognition of outstanding contributions to education. It is probably also necessary to contribute as well as harvest software. A seed educational effort, bringing programmers to the pilot schools and colleges for summers or one-year stints, would be an ideal – though clearly ambitious – plan. This could generate useful applications and attract much wider interest in the idea of developing free open source educational applications.

Conclusion

These three initiatives could yield huge dividends for education. Annual U.S. educational technology costs are projected at $6-25 billion and 20-25% of that is software. If FOSS were to halve or even quarter the cost of software, it could save anywhere from $300

(continued on page 8)

LINKS ON THIS PAGE
GNU/Linux—www.gnu.org
GNOME—www.gnome.org

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VHS Special Issue

VHS FACTS

1998–1999 SCHOOL YEAR

STUDENTS (Spring 1999)
female 269
male 266

STUDENTS (Fall 98 + Spring 99)
female 400
male 400

TEACHERS
female 22
male 14

COURSES OFFERED 36

SCHOOLS PARTICIPATING 68

STATES PARTICIPATING 17

TEACHERS WHO HAVE COMPLETED THE TLC 46

PROJECTED NUMBER OF FALL 1999 COURSES 100

The average VHS course has 18 students in 12 schools and 7 states.

OTHER COUNTRIES WHO HAVE PARTICIPATED IN VHS:

Germany
Singapore
Zimbabwe
Jordan

Virtual High School Breaks the Sound Barrier

Listening and Learning from the True Pioneers

by Lee McDavid

There are ten students in Washington, D.C., who are like every other student who logs into the Virtual High School™ web site to get assignments, join discussions, and just shoot the breeze with other classmates.

Except for one thing.

They're more familiar with typing out their thoughts than many VHS™ students because most of these students have used a TTY, a telephone system with a keyboard for the deaf.

"One of the great benefits for deaf students of participating in the VHS class is that communication with hearing teachers and peers is much more direct than using interpreters," explains Joyce Barrett, site coordinator for the Model Secondary School for the Deaf (MSSD). The school is located on the campus of Gallaudet University, the only university in the world for deaf and hard of hearing students.

Last fall five girls and five boys from MSSD were the first deaf students to sign up for VHS. At the beginning of the term Barrett contacted the VHS teachers who had her students and explained that they were from MSSD. But it was up to the discretion of the students themselves whether they wanted to divulge their deafness to their classmates. Some didn't, and some did. Those who didn't said it was because it was unnecessary. For those who did, the response that one student received was typical of all: "They treat me just the same." Those students who did tell their classmates were unanimous in saying they received a positive response.

What attracted the ten MSSD students to VHS was the opportunity to work independently and the challenging quality of the courses. As with many VHS students, the ability to take courses not offered at their own school was also a big motivation. They dove into everything from astronomy and poetics to government issues, photography, and sailing. "I love working independently," one student said in an MSSD survey. "I was very motivated because I had to depend on myself." Several students especially enjoyed the amount they were learning and the feeling of accomplishment, which one student described as more like a college-level seminar.

Many of the problems they encoun-

(continued on page VHS-8)

LINKS ON THIS PAGE
Model Secondary School for the Deaf—www.gallaudet.edu/~precpweb/index.html
Gallaudet University—www.gallaudet.edu

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Spring 1999

Truth or Consequences

Evaluating Online High School Courses

by Liz Pape

Now that many schools have spent a great deal of time, volunteer effort and money to network schools, the question many are now asking is "What do we do with it?" Will networks and the introduction of technology into the curriculum make learning easier for students? Will students be better motivated to learn? Will teachers be able to teach better, more effectively?

These are some of the questions that many school administrators are being asked, by parents, community members, and taxpayers. If technology is the tool, what is it that we are using the tool for?

For the past two and a half years, the Virtual High School (VHS) has been addressing some of these concerns. VHS is using technology as a tool to build online high school courses that are given over the Internet. Our experience has shown that it is possible to effectively use technology to offer high school online courses and that the VHS is a scalable model. VHS courses have given students throughout the country the opportunity to take courses that their schools are not able to offer, to work with students from a variety of locations and cultures, and to use technology daily while in their online NetCourses.

How do we know that these courses are as good as courses being taught in high schools across the country?

Although VHS courses are developed and taught by high school teachers, what additional support is given to them so that they might learn to effectively use this new medium? In VHS, quality of teaching and curriculum content is primarily influenced by our training program, called the Teachers Learning Conference (TLC), and by the online standards all VHS NetCourses are measured against. Potential VHS teachers must participate in the TLC, a graduate-level online professional development course developed and taught by VHS faculty. Teachers bring to the TLC their skills as high school teachers and we add online pedagogy and assessment skills. During training, as participants develop their courses, we evaluate the courses against criteria that we have developed. These criteria address areas such as the appropriate use of LearningSpace technology, appropriateness and

> **How do we know these courses are as good as courses being taught in high schools across the country?**

organization of content throughout the semester, and use of online assessment techniques. Once a teacher completes the TLC training course, he or she can offer a NetCourse to VHS students.

How is the quality of teacher and student participation evaluated in a NetCourse?

Because they consist of databases and reside on a file server, the entire course and all its interactions are archived and reviewed, both while the course is taking place and after it has ended. While the course is in progress, VHS national office personnel evaluate teacher and student attendance in the course, making sure that all are fully participating. Assignments

LINKS ON THIS PAGE
NetCourses—intec.concord.org/faq.html#num1
LearningSpace—www.lotus.com/learningspace
Teachers Learning Conference—vhs.concord.org/Pages/Main+Office-FAQ

and media resources are evaluated. Student portfolios are reviewed to make sure they are kept up-to-date, so that students can always know the status and grades of their submitted work.

Once a course is completed, we evaluate the entire semester's activities, including types of assignments, resource materials made available to students, discussions, and all submitted student work. Without actually participating in classroom discussions, we can review them, evaluating whether there is student-to-student discourse or just student-to-teacher discussions, checking to make sure that teachers and students are participating on a regular basis and that their comments show an understanding of course content. Students are also part of the evaluation and review process. Students take online surveys at the end of each semester, giving teachers additional feedback about the course and the instructional method.

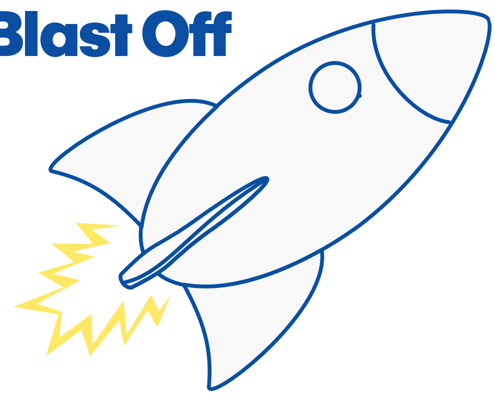
This year, the VHS national offices worked with professionals from universities and state departments of education to define standards for online courses and to create a NetCourse Evaluation Board. These standards will be used to evaluate courses during their development and implementation, and then after the courses have been completed and archived. The NetCourse Evaluation Board will be reviewing all archived VHS course offerings to suggest revisions before courses are taught again.

The online NetCourse standards are broken into two main categories: operational and instructional standards. Operational standards define the environment in which courses are taught and the personnel and technology resources that high schools should provide. Instructional standards are divided into three areas: pedagogical, assessment and curriculum standards. Pedagogical standards define how teachers teach in an online environment. Does the teacher work to create a virtual learning environment in the CourseRoom? Are expectations for course work clearly communicated to students? Have course materials and expectations been adjusted for individual learning needs? Does the teacher incorporate multimedia techniques in the NetCourse? Assessment standards define expectations for how teachers should communicate to students their grades and the status of submitted work. Are student portfolios kept updated? What feedback do students receive about submitted work?

Curriculum standards address course content. Online courses should have the following characteristics: engageability,

(continued on page VHS-4)

Two Teachers Blast Off



Robert Erger is a science guy. Christine Voigt is a wordsmith. What do these two teachers have in common? –The planet Mars.

"It was our big dream that we could have a course that incorporated math, science and social studies," explains Voigt, who is developing the cultural side of a two-course vision that she and Erger are creating in their VHS training course, the Teachers Learning Conference (TLC). Erger is a science teacher and Voigt develops curriculum at the ACT Academy in McKinney, Texas. They plan to teach their classes next year in VHS.

"There is so much history in the space race," explains Erger, who came to teaching after 13 years as an engineer. His course, which he envisions running concurrently with Voigt's, covers the science side of the equation and is called "BLASTOFF." While his students are building model rockets and solar cars, Voigt's students will be studying our cultural fascination with space since the Renaissance in her class "From Earth to Mars." Occasionally their course content will overlap, such as when students read and discuss together the novel *Contact*. Both courses converge later in the year to plan the colonization of Mars, one from the math and science perspective, the other from the perspective of its impact on the prevailing social culture of art, music and literature.

"The hardest thing for me is planning a whole year ahead of time," explains Voigt. For Erger the biggest challenge is thinking up ways to engage kids who will be far away. "Some people, when they move to teaching in a virtual environment, think the same way. For me, it's a paradigm shift."

Voigt agrees. Asked if she could have designed her online course without taking the TLC, she says, "I probably would have thought that I could, but after being in it, I have the perspective of the student and what happens."

Even though the time commitment has been considerable and the technical challenges occasionally daunting, they are excited by teaching in VHS next year.

Says Erger, "When I see other teachers developing things, I'm jealous. I wish I was a kid."

LINKS ON THIS PAGE
Teachers Learning Conference—vhs.concord.org/Pages/Main+Office-Want+to+Join

Truth or Consequences

continued from page VHS-3

higher level questioning, critical thinking, problem-solving, hypothesizing, reading for comprehension and interpretation, data collection, analysis, synthesis and evaluation. VHS NetCourses should be an opportunity for the student to master a limited number of concepts in depth, rather than many concepts at a minimal level. Wherever possible, learning objectives should be mapped to national standards, and an interdisciplinary approach is encouraged.

The development of an effective online professional development model, rigorous evaluation of NetCourses before, during and after their implementation, and effective administration by VHS national offices assures a satisfactory experience in continuing years.

Virtual education can never replace the social learning environment within a school. However, virtual instruction can become another effective vehicle for strengthening our instructional programs and course offerings.

By merging the best in instructional practice with the best in current technology, we can demonstrate the potential of network and information technologies in public education. But most important, VHS shows that public education can place students at the forefront of knowledge and experience internationally and prepare them for the demands of either the workplace or further education. @

Liz Pape is the VHS administrator. For more information on the TLC, see page VHS-3. Liz@concord.org

All In a Day (and Night)

Long Hours and Hard Lessons Online

So you read that online teaching is the wave of the future and you want to try it. You take a class that teaches you how to teach online. You work day and night designing a course. One day you find yourself with a virtual classroom of twenty students spread out online all across the country. You spend months putting into practice all the things you learned about online collaboration, threaded discussion groups, and multimedia presentations. At the end of the term, you pat yourself on the back, you're an honest to goodness experienced online teacher. So how do you feel?

Exhausted! say many teachers.

"Everything took more time than I would have expected," explains Marsha West, who teaches WebQuest from Forks High School in Washington. Writing lesson plans, responding to questions, making assignments. The usual. But it all takes place on the computer.

"For me, the hardest thing about actually teaching a VHS course as opposed to the theory of teaching a VHS course has been juggling all those different things at the same time," says Susan Leavey, who teaches photography in Marlboro, Mass. "Some days I have 30-40 comments, questions, assignments to try to keep up with and answer on top of my teaching load and life as we know it."

No doubt about it, for a VHS teacher committed to teaching well, the time commitment is considerable. So is the need to be creative. How do I get students talking to each other? How do I develop rapport with students I can't see? How do I get reluctant students to respond? How do I assess student work from a distance? What do I do about a student who doesn't come to class? "It was a humbling experience for me to have students fail regardless of what I tried to do," says Leavey. But she also had some "great students who knocked my socks off with the quality and thoughtfulness of their work."

Teachers face other surprises in the virtual classroom. "There's far less room for 'winging it' for teachers in an online environment," says Matt Huston, who taught in Los Lomas High School, Calif.

Teachers like David Jost, who teaches music at Westborough High School in Massachusetts, believe that the VHS preparatory class, the Teachers Learning Conference (TLC), is essential for learning new skills, but also for experiencing an online course from the students' point of view. "It made me realize what the students were going through in my own class," says Jost. "I was able to see how VHS actually looked and felt."

"The TLC is where it's at for anyone beginning to work in this area," agrees David Senecal, who teaches one of VHS's most popular classes, Project Sail. "[TLC] gives you the training to utilize the software for developing your course and also the opportunity to create a methodology for delivering your class."

Jerry Lapiroff has been watching all of this from somewhat of a distance. He is a VHS site coordinator in Fremont, Calif., where he helps VHS students with their courses. "I never expected that – even the first year – some students would find an online course the best experience of their high school careers," he says.

So rest up, teachers. It may be a sign of your success that student enrollment is expected to double next year. @

LINKS ON THIS PAGE

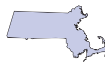
Forks—www.forks.wednet.edu
Westborough—www.westborough.org
Las Lomas—www.laslomas.acalanes.k12.ca.us
Marlboro—www.marlborough.com/edu/high.html
Fremont—www.infolane.com/k12/jfk

Who Are VHS Students?

The high school students who sign up for VHS courses do it for many different reasons and come from various backgrounds. Here are profiles of a few from the Class of 1998-99.

Jennifer
Miramonte High School

Jennifer is a fierce competitor and consequently a world traveller. She was an alternate last year to the USA Women's Wheelchair Basketball team which went to Australia, and she competed in the 100m, 200m and 400m races at the 1998 World Championships in England. She returned to Australia this April to compete in the Junior National Wheelchair Games. Jennifer likes the freedom of VHS, but she had to get used to emailing a question to her teacher and sometimes waiting a day for the answer. She is taking the VHS course Introduction to Computer Programming, which she calls a "fun class," in part because she "wanted to go into a class that I knew would be full of boys and show them that girls can succeed at programming as well."



Charles
Shrewsbury High School

After only two years Charles is what you'd call a VHS veteran. "I was there from the very beginning," says Charles, who weathered the early days of server crashes and other glitches. "It took a lot of patience, but I made it through as a better person." He first heard about something called an "online classroom" at an informational meeting at his school. "I learned that Virtual High School curriculum, although conducted over the Internet, was anything but centered on computers. In the end, it was the courses that made up my mind on

(continued on page VHS-6)

VHSZine
Online Newspaper Keeps Students and Teachers in Touch

For the latest school buzz, point your browser to the online paper for VHS students and faculty – VHSZine – where you'll find interviews, personal stories, politics, and poetry. "I would say that the number one objective of the newspaper is to give the students and staff a chance to share with each other more than on a strictly academic level," explains Augusta Patterson, a graduate student at Marlboro College in Vermont, and editor of VHSZine. She and Storie Frost, who does the web work, pull the paper together every few months.

Patterson works with a core group of seven student volunteers to write and edit articles by students and staff. Everything from movie reviews to a discussion of the NetCourse Evaluation Board can be found in the 'Zine, which started in fall '98 and is now in its third addition. "We are hoping that as interest in the VHSZine grows, it will serve as an alternative means of expression for all the people involved with VHS," says Patterson. Anyone interested in contributing to VHSZine can contact her at: webster858@mediaone.net

http://vhs.concord.org/Pages/Campus+Life-Newspaper

VHS Parents and the Online Classroom

This spring over 500 students are taking VHS courses. What do the parents think about the online courses their sons and daughters are taking? What are the special challenges for parents of online students?

Ruthanne Adams is in a unique position to keep track of her daughter Caitlin's participation in VHS. Adams is a VHS teacher herself, in Massachusetts. "I appreciate the ability to have access to the assignments and day-to-day teaching that goes on," explains Adams. She regularly logs into the VHS site and views Caitlin's contributions and assignments. "I can attest to the fact that my daughter has worked more and harder on this English class than any she had previously taken."

Nancy Vachani, in California, agrees that her niece is more self-motivated in her VHS class than in other classes, and Vachani appreciates the diversity of classes available because of VHS, but, she says, "I do not feel quite as connected to the classroom work." She finds it harder to gauge the amount of homework in the class and the instructor's teaching style when there is no back-to-school night in which they can meet and talk. She would like to see more direct communication from the school or teacher about her niece's progress in her VHS class, much like what she receives from her regular classes.

Both Adams and Vachani are periodically frustrated with the technology, which sometimes seems to thwart their best efforts to log into a class. But they agree that, in Vachani's words, "in general the pluses outweigh the minuses." They are committed to working out new ways of communication that can bring kids, as well as their parents, into the online classroom. @

LINKS ON THIS PAGE

Women's Wheelchair Basketball—www.unomaha.edu/~brasile/usawomen.htm

Not Chat Not Email

by Marsha West

When people ask me how Virtual High School "works," they almost always refer to chat lines or email. But VHS doesn't depend on either of these. In educational-techno-speak we call LearningSpace a "collaborative, asynchronous environment for active learning"! In ordinary English, this means that students work together, but not necessarily at the same time, to plan and present their work – which may include multimedia presentations, essays, research papers, creative writing, debates, seminars, or panel discussions – all the same kinds of things they do in regular face-to-face school.

The one thing I have become more aware of as a NetCourse teacher is that the VHS experience is more *like* a regular high school experience than it is *different*. You have to get to know your classmates. You have to risk sharing your ideas, exhibit good communication skills, practice good manners, learn to be flexible, develop good study skills, including time management and ethical use of source materials. You have to learn to communicate effectively with your teacher and your teacher has to learn to communicate effectively with the class and appropriately with each individual student. You have to find a proper balance of formality and informality.

From the teacher's point of view, the challenge is to make the virtual classroom seem as real as any physical classroom – providing interesting and challenging assignments, making meaningful connections between different topics that come up, modifying instructional techniques when appropriate, being sensitive to the "teachable moments" that arise from spontaneous interactions with students you come to know well but never see. One of the most important goals in my class, WebQuest: a Literary Odyssey, which is a modification of an AP English course I have taught for nearly 20 years, is to foster critical thinking skills and a mature level of discourse in class.

In one discussion thread, the students maintained a high level of energy over a considerable period of time. The comments ranged from casual to profound, but the general level of discourse was extraordinary for high school students – more typical, perhaps, of a college seminar. The students were able to communicate voice, personality, and tone in an all-text environment, which shows how discussion in a NetCourse can be perhaps even better than in a face-to-face group. No one gets interrupted. Everyone has a chance to reflect on what others have said and formulate a thoughtful response. I try not to dominate these discussions, but interject comments to raise issues, encourage participation, or just to make sure that I am perceived as "being there."

So it truly isn't chat, which is notoriously shallow and fosters sloppy thinking. And it isn't email, which corresponds more to passing notes in the back of the class than it does to dialogue in a classroom. Conversation in LearningSpace is collaborative; it is energizing; it aids learning; it fosters accountability. It facilitates the use of higher level thinking skills and prepares students to be effective workers in the world's online business environment. And because all that discourse becomes part of a permanent database, it is perhaps the best possible means of tracking what actually goes on in a classroom for the purpose of improvement of instruction. @

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VHS Students
continued from page VHS-5

whether I would take Virtual High School." Over the past two years he's taken Earth 2525, A Model UN Simulation, and Business in the 21st Century. He's currently enrolled in Web Page Design. Although similar in content to his regular classes, his VHS classes have added a whole new meaning to getting to class on time, he says. "All of my classes were occurring 24 hours a day. I sometimes saw people passing in assignments and contributions to class discussion at two in the morning." He found himself carrying on serious discussions with other students long after the class had moved on to other topics. As Charles explains, "Any person who states that communication over the Internet is impersonal really has no clue what he is talking about."

Talib
Hoover High School

Talib came to the United States from Pakistan looking for better educational opportunities. He enrolled in Hoover High School in Ohio his junior year and took two VHS courses before graduating and being accepted to Ohio State University, where he is now a freshman. Although VHS offered him the freedom of coming to class on his own schedule, it turned out to be one of its biggest challenges. "I think the hardest part of VHS is self responsibility," he explains. "There is no physical teacher watching what you are doing." Talib also liked the variety of classes offered, and being an avid astronomer, he took Stellar Astronomy. "[VHS] is more like independent study and it is more challenging," he explains. Wanting to improve his web design skills, he enrolled in Writing Through Hypertext and created a project on the provinces of Pakistan, which can be viewed in the Showcase section of the VHS web site. @

LINKS ON THIS PAGE
Showcase—vhs.concord.org/Pages/Campus+Life-Showcase
LearningSpace—www.lotus.com/learningspace

VHS COURSES 1999-2000

http://vhs.concord.org/Pages/Academics-Home

101 Ways to Write a Short Story
A Model United Nations Simulation Using the Internet
A Shakespeare Who-Dun-It
Aeronautics and Space Travel and Record-breaking with Model Airplanes
American Popular Music
AP Statistics
Astronomy: Stars and the Cosmos
Atmospheric Interactions
Aviation History
Beyond Today
Bioethics Symposium
Biology II - A Second Year Course
BLASTOFF – Building Lead Associate Scientists Through On-line Fabulous Frontiers
Calculus for Business
Career Awareness for the New Millennium
Computer Graphics on the Internet
Connecting Mathematics and Science Through Technology
Current Issues in Nutrition and Health
CyberReporting
Democracy in America?
Deutsches Cyberabenteuer (German Cyber Adventure)
Chemistry II
Earth 2525: A Time Traveler's Guide to Planet Earth
Earth Dynamics
Eastern and Western Thought: A Comparison
Employability Skills
Environmental Ethics
Ethnobotany
Evolution and the Nature of Science
Evolutionary Genetics with a Biotechnology Twist!
Expanding Artistic Vision Through Photography
Explorando culturas hispanas a través del Internet
Exploring America through its Writers
Exploring the International Business World
Exploring the Wonderful World of Multimedia
Exploring Themes in African-American Literature
Folklore and Literature of Myth, Magic, and Ritual
From Earth to Mars: A Study in the Humanities of Space Exploration
Getting to Greatness: Composers and Their Music with You as the Critic
Heroes
History and Science: There's no divorce in this marriage
History and the Silver Screen
Informal Geometry: A Construction Approach
Interdisciplinary French ThinkQuests
International Diplomacy – A Simulation-Based Diplomatic Exercise
Introduction to Botany
Introduction to Computer Programming
Introduction to HTML
Introduction to Microbiology
Introduction to Ornithology
Investing in the Stock Market
Java Programming Basics
Leonardo DiCaprio to Mel Gibson: Shakespeare in Films
Logic, Deductive Reasoning and Proof
Malaria: A Case Study for Understanding Biology
Marketing With Probability
Mathematical Problem Solving
Music Appreciation and Composition
Music Composition and Arranging
Mythology – Stories from Around the World, from the Beginning of Time, to the End of the Earth
Narrating Family Histories
Natural History of the Southeast: A Case Study of Georgia
Number Theory: Patterns, Puzzles and Cryptography
Oceans: Living Space for the Future
Páginas en la Red en Español (Spanish Web Pages)
Paleontology: Exploring the Earth's Record of Life
PeaceMaking
Personal Finance
Perspectives in Health
Photography as Visual History
Political Science Honors
Pre-Engineering and Design – A Problem Solving Approach
Problem Solving – Fact or Fantasy
Programming a Robot Arm Using Visual Basic
Project Sail
Research and Technology
Russian, Soviet and Post-Soviet Studies
Same as it Never Was: Viewpoints on What Really Happened Throughout the Course of History
Science Apprentice Teacher
Scientific and Religious Perspectives on Life and Intelligence
Screenwriting Fundamentals
Seminar in Women's Literature: "A Sense of Place"
Southern Writers
Space Technology On-Line
Survey of African American Literature-History
The American Music Heritage – Song and Society
The Thinking You
The Vietnam War
There's Nothing New Under the Sun (or is there?)
Three Tracks to Latin
Time, Space, and Other Things
To Kill a Mockingbird: Maycomb – Microcosm to the World
Twentieth Century Women Authors – A Reflection of a Changing America
United States Government Issues
Visual Basic 6.0
Visual Physical Science
Web Writing
WebQuest: A Literary Odyssey
World Area Studies/Current Events
World Conflict – A United Nations Simulation
World Literature on Film as it Reflects the Continental Experience

Breaking the Sound Barrier

continued from page VHS-1

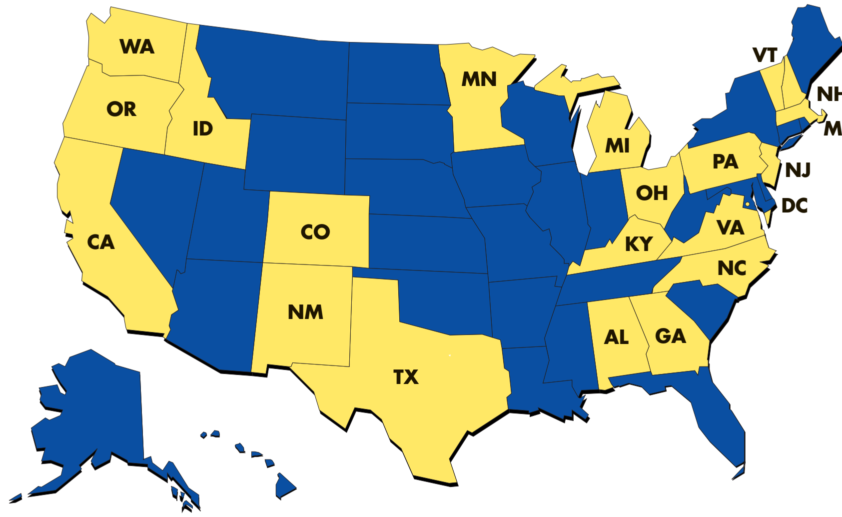
tered were things that any VHS student might complain about: the server going down, having to wait for a response from a teacher to a posted question, or the cancellation of a class. One challenge for some deaf students is the fact that written English is like a second language for them. American Sign Language is their first language. Consequently, some, but not all, might need help understanding the meaning of a statement or a word, much the same way an ESL student would.

But these challenges were not insurmountable. In fact, many students relished the higher expectations. According to Ron Baldi, one of two MSSD teachers who supervises the VHS students, "One of the most satisfying things for me as a teacher is seeing our students succeed in a program with hearing students. The VHS program puts them on a fairly equal footing as far as accessibility goes. . . . I've already seen carry over of experiences our students have gained in VHS into the classes here at MSSD, which has enhanced their background knowledge of subject areas and improved their performance in classes."

Early on MSSD recognized that as the first deaf school in VHS, they were the pioneer of pioneers, and so they decided to provide their students with additional support: a site coordinator as well as two supervising teachers. The extra support has paid off, and according to Mary Ellsworth, the other MSSD supervising teacher, there are benefits for everyone. "The students had an excellent experience with in-depth learning and real world expectations, which is very critical for their success in the future. I can think of no better way to have them do it – connected, yet supported by the environment here at MSSD." As a teacher she also has gained from observing the work of VHS teachers. "There are very creative teachers in VHS modeling excellent technique," she says.

VHS 1999 - 2000

Participating States



One hundred and ten schools in 19 states are expected to participate in the Virtual High School next year. Enrollment is projected to top 2,000.

But there are things for VHS teachers to learn as well. An assignment that includes listening to music or watching a movie can leave a deaf student unable to participate. Ironically, multimedia files, whose combination of sound and visuals is generally treated as a great leap forward in online education, are a problem for deaf students unless the file is also captioned.

Although there have been some hurdles to overcome, MSSD remains committed to VHS. "The Virtual High School project not only enables students to participate in an endeavor that is reflective of future trends," observes Katherine Jankowski, the school's director, "but allows them to participate with their hearing peers from all over the United States on a level playing field."

Barrett hopes that one day a Deaf Studies class could be offered in VHS which would cover deaf culture and issues, including information on how interpreters, TTYs, and sign language are used. She also hopes that mainstreamed deaf students, who may feel isolated in schools where there are not many students like themselves, might be motivated and encouraged to participate in VHS if they knew there were other deaf students in their classes. "Just a thought," Barrett says. But the idea of any deaf student joining VHS was *just a thought* once, too. @

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LINKS ON THIS PAGE

MSSD—www.gallaudet.edu/~precpweb/pcpmssd.html

American Sign Language—dww.deafworldweb.org

Participating States—vhs.concord.org/Pages/About+Us-Where+is+VHS

Speaking Up for Online Education

Pressure Grows In Education to Define What It Is and What It Isn't

by Raymond Rose

In *Blueprint to the Digital Economy: Creating Wealth in the Era of E-Business*, author Don Tapscott writes, "Every company will become an 'education' company or it will fail. If your company doesn't have plans to establish its own 'college,' it is probably in trouble."

As business becomes more global in scope, online education is being developed as a cost-effective vehicle for capturing information and training employees. As corporate teaching sites begin using network-based technology to deliver content, the pressure on traditional institutions of higher education to make similar changes increases.

Industry is not the only source of pressure forcing education to adapt. Within the post-secondary education community, there is increased competition for students. Those institutions with distance education programs have an advantage; they are not limited to enrolling students in their immediate geographic area. Other changes are reshaping the nature of education. Only one-fourth of the undergraduate population fits the traditional image: 18-22 years old, attending full-time, and living on campus. The rapidly growing student population is becoming older and more diverse, and they are demanding flexible schedules and off-campus learning opportunities. The pressure is clearly on higher education to change.

> **Within the post-secondary education community, there is increased competition for students.**

In an effort to respond, many colleges and universities now require their faculty to participate in some form of what they refer to as "distance learning" or "online education." These terms, which have been bandied about for some time, are used to describe everything from correspondence courses and classic television delivered lectures to email-based classes and web pages. The most common *online* activity in higher education today is the posting of a professor's lecture notes to the Web, something which shouldn't be called online education. A more appropriate term is a "web-enhanced" course. This method allows large numbers of students access to the information, but provides little or no opportunity for a collaborative classroom environment. While web-enhancing a course can be the first step in moving to more interactive distributed online education structures, there are many higher education faculty who have yet to grasp the full potential of online education.

> **Detractors paint all the approaches to online education with the same negative brush. But synchronous and asynchronous methods should not be linked together and discussed as online education.**

Change is taking place in public schools as well. At one end of the spectrum are virtual schools with the objective of providing a complete curriculum of courses and a high school diploma to students who will never enter a brick and mortar school. At the other end of the spectrum, there are traditional schools who believe the role of technology is merely to enhance traditional courses held within the local school.

Given the phenomenal growth of online education, it is ironic that there is not yet a body of research that can tell us just how effective online education is. Its detractors paint all approaches with the same negative brush. But synchronous and asynchronous methods should not be linked together and discussed as online education. There is as much variety of approach within each of those categories as there is across them. Nevertheless, the growth in online education will take place with or without the research. Those of us developing it are looking at the anecdotal and practical feedback from the students and teachers as indicators of its success.

At The Concord Consortium, we run the Virtual High School, whose philosophy is somewhere between the extremes currently operating in public education. VHS, the largest virtual school in the public school arena, does not aspire to compete with the local school curriculum, but seeks to augment course offerings with

(continued on page 8)

LINKS ON THIS PAGE
Virtual High School—vhs.concord.org
INTEC—intec.concord.org

New Technology

continued from page 7

subjects that are not generally available in high school, courses such as Connecting Mathematics and Science Through Technology, Environmental Ethics, and Ethnobotany.

VHS students consistently report feeling closer to and better acquainted with their online teachers than with their local teachers. I have heard similar reports from higher education faculty who teach online courses. We also have had reports that VHS has kept potential dropouts interested in school. VHS teachers say that their online teaching experiences have positively affected their face-to-face teaching. On the other hand, asynchronous course delivery, which is the VHS model, consistently has a 20% dropout rate which needs to be investigated. Hearing impaired students are currently participating successfully in VHS, but visually impaired students have hurdles to clear before they can join VHS. We are just beginning to explore the impact VHS is having on education. Clearly, the effectiveness of netcourses needs more research.

VHS students consistently report feeling closer to and better acquainted with their online teachers than with their local teachers. I have heard similar reports from higher education faculty who teach online courses.

Another of our programs, INTEC, was proposed as an alternative to the summer institute version of professional development familiar to many teachers. INTEC's development was based on school improvement research and the direct experience of online instructors. The resulting seminar-based model requires small, local teams of teachers, who participate in occasional face-to-face gatherings, to also take part in substantial online discussion with participants in study groups at distant sites. Only the local study group meeting is synchronous (everyone meets at the same time). The online course segment is constructed around the seminar (netseminar) model as well, with participants taking an active role in discussions. To do this, activities require participants to work on the same content during the same time period, something we call scheduled asynchronous instruction.

INTEC has been successful in providing a quality professional development experience for a large number of teachers. There are significant online discussions taking place between teachers across the country. It is clear that the project is having an impact on teaching and learning. But INTEC has also experienced an attrition rate that is higher than the average for asynchronous courses. We need to do more research to address this important issue.

Both INTEC and VHS are on the bleeding edge of online course delivery. Many people watched and waited to see what would happen, while others joined in. Online education is here to stay, and we look forward to discovering its full potential for expanding educational opportunities. @

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Free and Open to All

continued from page 6

million to $1.5 billion a year. Another way to look at that savings is that if only a fraction of that money were used to research, test, develop, and adapt FOSS to education uses, the quality and suitability of software would improve enormously.

If this software required less support, less teacher training, and ran on less expensive computers, these savings would be higher still. If the availability of quality Free Open Source Software increased student, teacher, parent, and community acceptance and use of technology, the positive results would be incalculable. These gains could be important to many schools, but at poor schools and schools in developing countries it might make the difference between having and not having adequate educational resources to prepare students for the Information Age. @

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LINKS ON THIS PAGE
INTEC—intec.concord.org
VHS—vhs.concord.org

The Inquiry Dilemma

How To Assess What We Teach

by Paul Horwitz

Imagine that you are a piano teacher and you want to find out whether your students are learning how to play the piano. Do you (1) have them play the piano for you, (2) give them a multiple-choice test, or (3) ask them to write a 600 word essay on piano playing?

If you picked the first choice, consider the way we decide whether our students have learned science. We give them several hundred completely unrelated questions and ask them to pick the "right" answer from four confusingly similar ones. And we require that they do this in a time period carefully calibrated to be too short for useful reflection, much less serious problem solving.

We profess to value inquiry skills, but we test for recall of knowledge and mastery of superficial heuristics. This at a time when the National Science Education Standards assert that "rather than checking whether students have memorized certain items of information, assessments need to probe for students' understanding, reasoning, and the utilization of knowledge."

Why do we do this? Leaving aside whatever social forces may be at work to retain the status quo, it is undeniably difficult to assess reasoning and inquiry skills on a passive test. How do you gauge a student's ability to think when your only input is the answers to an endless list of questions? How does one reward curiosity on a multiple choice test?

What we need is a way to create "active" assessments that engage students in authentic problem solving activities but can be easily scored. To do this, we must be able to monitor, record, and react to student actions, provide them with help when necessary, and confront them with probing questions in the context of a sustained, constructive task.

"THEN, AS YOU CAN SEE, WE GIVE THEM SOME MULTIPLE CHOICE TESTS."

Sidney Harris

Technology may offer an answer. Computers are dramatically changing not only how we teach but what we consider it important to teach. It is surely no coincidence, for example, that our current emphasis on cognitive and communication skills coincides with the imminent onset of an information age in which such skills will presumably increase in importance. Hand in hand with this "cognitive tilt" in education have come new ways of using computers to teach students how to reason from data, how to make and revise mental models, and how to use graphics for communication. Isn't it odd that none of this has altered what we assess, or how?

Here at The Concord Consortium we hope to change that. Well, not all at once, of course, but we think we may be able to take a first step.

For years now, the folks in our Modeling Center have been creating fun, computer-based environments that help students learn to "think like scientists" by giving them manipulable models of real objects. They can build rocket ships that travel at close to the speed of light, or fiddle with genes and watch an organism change. They can wonder how the speeding knight is going to squeeze his foreshortened lance between the doors of the barn, or try to guess the color of an invisible dragon by observing its offspring. These puzzles are hard, but not too hard. They take a long time to do, but not so long that kids get frustrated. They are fun, but not mindless fun – they reliably provide the "Aha!" experience that is the basis of all good teaching. They make marvelous assessment items.

GenScope™ is a manipulable model of genetics. It offers students representations of genetic information at multiple levels, from DNA to populations. It lets them manipulate this information and observe the effects of their interventions. It has been used successfully from middle school to college to help students reason about observable phenomena in terms of underlying causes that are not directly perceivable. (See @CONCORD Winter 1998 for a description of GenScope.)

Imagine using GenScope to determine whether a student has learned genetics. What would you do? One possibility would be to give the student

(continued on page 10)

LINKS ON THIS PAGE
Sidney Harris—www.sciencecartoonsplus.com
@CONCORD Winter 1998—www.concord.org/library/newsletter.html
Standards—www.nap.edu/readingroom/books/nses/html/overview.html#organization
Genscope—genscope.concord.org

Inquiry Dilemma

continued from page 9

a problem to solve (the one with the invisible dragon, say), set up GenScope, and then sit back and look over the kid's shoulder as she tries to solve the problem. You would be careful to note critical events (e.g., which particular dragons does she choose to cross with the invisible one?). You might offer hints (e.g., "You can look at the genes of the offspring, you know") and react to specific actions by posing questions ("Why did you choose to do that?"). When the student solves the problem you congratulate her and give her a related one that builds on the first. It might take a while, but at the end of a class period spent this way you have a pretty good idea of how much the student learned.

A group of us on the GenScope project have spent countless hours doing exactly this kind of evaluation. We have learned a lot from the experience. We have learned how to formulate the right sequence of problems, we have learned when to give hints, we have learned what questions to ask. But this approach to assessment is time consuming and much too labor intensive ever to constitute a viable alternative to, say, the SAT test. Can the process be automated in any way?

Enter BioLogica™.

We are currently developing a new program, based on GenScope, that solves this problem. BioLogica is not a standalone application like GenScope. Rather, it consists of a collection of applets that run under the control of an executive program, which itself is controlled by scripts that can be written by researchers, curriculum developers, or teachers. (See @CONCORD Spring 1998 for a description of BioLogica.)

A typical BioLogica script will pose a challenge to the students and then set up the BioLogica interface to match the challenge. It will make available particular applets, for example, set up the screen layout for them, and add menu items and tools that match the investigation. It will then monitor the students as they work using "listeners" – software agents embedded in the applets. This enables the script writer to record what the students are doing and to intervene at propitious moments. Thus, at various points in the investigation – for instance, when the students make the first cross – the script may offer hints, or provide feedback to the students' actions. It may alter the functioning of BioLogica, for instance, prohibiting additional crosses until the students have answered a question. It can prompt the students to enter notes or screen shots into their personal portfolios, and it can record significant events automatically into the same portfolios. At particular "teachable moments" it can suggest that the students call their teacher over for a discussion.

Scripts are a powerful tool for producing active assessments. The assessment items can be as linear or as open ended as one might wish. They can be embedded in teaching activities, or presented by themselves. They can be programmed to record appropriate data and can then use that data to calculate an overall numeric score.

BioLogica is just now coming online and the process of writing scripts has only just begun. So we can't say, at this juncture, whether we will succeed in creating active assessments that really reflect a student's understanding and ability to reason about biology. We are like kids ourselves, kids who have been given a new, more powerful Lego set. We don't know what it can do yet, but we're eager to find out. @

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Assessment Conference

An Invitational Conference on "Assessment in the Information Age" will be held June 21–22 at Shelburne Farms in Vermont, a lovely rural location convenient to the Burlington airport.

The conference will bring together researchers in education, social psychology, computer science, psychometrics, and other disciplines to discuss the implications for educational assessment of advances in learning theory and information technology. Participants will focus on the questions "What changes do we expect in the next century in what we teach and how we teach it?" and "What do these changes imply for what we assess and how we assess it?" One of the desired outcomes of the conference is the creation of innovative proposals.

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Genscope—genscope.concord.org
@CONCORD Spring 1998—www.concord.org/library/newsletter.html

Perspective

Challenges to Innovative Research Partnerships

by Sherry Hsi

> **"How do we accelerate large-scale adoption of innovative approaches to learning and teaching with technology?"**

We commonly hear optimistic reports that computers, digital multimedia, and the Internet are transforming work practices, social relationships, and organizations. Yet, as we approach the millennium, computers have made limited impact on learning and teaching in K-12 schools. Although more schools than before are networked to the Internet, including both wealthy schools (87%) and low-income schools (80%) according to a recent U.S. Department of Education survey, educators struggle with the new forms of pedagogy and technology fluency needed to use computers effectively for learning and instruction.

As we all know, computers aren't quick fixes to education. Yet for over 20 years, education researchers have been demonstrating robust learning with innovative approaches mediated by technology while also providing the data necessary to show why these approaches help kids learn. These innovations and empirical results are not widely known outside of research communities. Even within these communities, the successful transfer and communication of research from one test bed to another in a different setting is rare. How do we accelerate knowledge-sharing and large-scale adoption of innovative approaches to learning and teaching with technology? How can we demonstrate the effectiveness of learning technologies that scale beyond a small set of classrooms or a narrow segment of the curriculum? The National Science Foundation's Learning and Intelligent Systems initiative has been supporting multidisciplinary partnerships that cut across sectors. The Center for Innovative Learning Technologies (CILT) is an example of such a partnership.

Since the fall of 1997, CILT has been exploring and documenting the nature of multi-institutional collaboration between four institutions: The Concord Consortium, the University of California at Berkeley, Vanderbilt University, and SRI International. CILT aims to foster a new model of collaborative research that capitalizes on accumulated research findings, distributed community contributions, and ongoing synthesis, reflection, and incubation of new ideas in the area of learning technologies.

There are many challenges to organizing a cohesive community. Four workshops hosted during the year by CILT attracted participants from industry, commercial business, schools, training institutes, government, scientists, universities, and private foundations. With different constituencies came different methods and competing goals to solving the "education problem." Even among education researchers, there was no consensus on approaches to education assessment and reform. A large part of the community-building discussions involved reaching common ground. Although everyone was passionate about improving education, everyone had different criteria for what counts as "learning" and how to "design for learning." Would it be a cheap high speed networked laptop, or better teacher professional development, or a set of curricular design principles, or uniform learning assessments, or the ability to openly share software source code?

CILT strives to provide concrete support for ongoing multidisciplinary, multi-institutional collaborative activities like these. However, achieving the degree of mutual understanding or collaboration needed to spark breakthroughs requires a completely new way of thinking and working. We are banking on learning technologies to facilitate this breakthrough. @

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U.S. Department of Education—nces.ed.gov/pubsearch/pubsinfo.asp?pubid=1999017

National Science Foundation—www.nsf.gov

Center for Innovative Learning Technologies—www.cilt.org

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Join Us Online

International Project for Grade School

The South Avenue Magnet School in New York's Beacon City School District is collaborating with The Concord Consortium on a year-long international project for fourth graders. Students from the United States are linked through the Web with two other international sites to build a miniature Global Neighborhood using their combined local designs. Students are studying local ponds and streams, building simple and complex machines, and investigating energy use in their local neighborhoods. Blueprints of designed neighborhoods, cultural characteristics of sites, and any data collected in the studies will be shared over the Web to provide a better understanding of the needs of the shared "virtual neighborhood."

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Reading the Rocks

Reading the Rocks is an interactive Web site produced by The Concord Consortium for the American Museum of Natural History in Washington, D.C. Designed to support the Museum's new geological collection soon to be on display in the Gottesman Hall of Planet Earth, the web project is being developed for middle school teachers and students. Nationwide viewers, many of whom may never have the opportunity to visit the exhibit, will be able to use an interactive database; explore the AMNH collection of rocks; work in virtual laboratories that mirror professional labs; and participate in a number of online educational activities.

http://www.amnh.org

Computerworld Smithsonian Medal Award

On Monday, April 12, almost 400 of the industry's lead innovators, from as far away as Argentina and Hong Kong, gathered on the mall in Washington, D.C., to see their work accepted into the Smithsonian Permanent Research Collection of Information Technology. The Concord Consortium, nominated by Lotus Development Corporation in the education and academia category, received a medal for its creation of the Virtual High School.

"The primary source material submitted by Concord Consortium will enrich the National Museum of American History's growing collection on the history of information technology," said Spencer R. Crew, director of the National Museum of American History.

The permanent collection, established in 1989, is the world's premier historical record of computing applications and innovations. Information on the Virtual High School is housed at the museum with applications of technology from 42 states and 22 countries.

"The Laureates in this year's collection are utilizing new information age tools to extend the benefits of technology to society," said Dan Morrow, executive director of the Awards Program.

http://www.thunderstone.com/texis/si/sc/innovate/+pxehfoh+wBmeFuV6W0xww/brief.html

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