R&D Effort Develops

Center for Innovation in Learning Technologies Provides Fertile Ground for Collaboration

by Robert Tinker

Recognizing the need for more research and development in educational technology, the Concord Consortium has joined with three other leading research and development groups to launch the Center for Innovation in Learning Technologies (CILT). The project is a joint activity of the University of California at Berkeley, SRI International, and Vanderbilt University, whose web site has information about the collaboration.

Already CILT has identified five areas that have great promise for education, but which need substantial research and development before their promise can be substantiated and supported. Each area has a research plan in place and CILT is currently recruiting post-doctoral fellows who can spearhead innovative projects in these five theme areas, which have potential for important advances in education across the K-14 spectrum.

Research will emphasize the importance of carefully designed activities that engage the learner in acquiring a combination of skills, concepts, and mental models through active engagement in guided inquiry, exploration, challenges, reflection, and communication. Technology can support these learning strategies by providing access to new collaborators, mentors, and teachers; enhancing the range of inquiry with more powerful tools; helping students visualize and model complex situations; and supporting alternative, authentic methods of evaluating student performance.

Starting with this perspective on educational and technological needs, the CILT participants searched for breakthrough opportunities where a national collaborative structure could make major contributions. To provide substance to our collaboration, we needed to identify opportunities close enough to reality that we could create prototype technologies that can be tested by our colleagues in a variety of real classrooms and other learning contexts. At the same time, the

R&D Effort

technology must *not* be transitory; we need to rely on the technology's wide availability and continual improvement over the next decade.

Some of the most respected names in educational technology research and development have become part of CILT. Besides the four founding institutions, BBN, Educational Development Center, The Center for Children in Technology, the University of Illinois at Urbana-Champaign (UICU), Georgia Institute of Technology, the MIT Media Lab, Northwestern University, NCSA, TERC, the University of Michigan, and Xerox PARC have all signed on.

After much discussion the following areas were selected for investigation:

Enabling Tools for Electronic Learning Communities. Developing and testing software that can support collaborative learning on the 'Net. Directors: Roy Pea, SRI International, and Jeremy Roschelle, University of California at Berkeley.

Visualization and Modeling. Educational use of various kinds of computer-based models and representations to help learners understand complex, interacting systems. Directors: Marcia C. Linn, University of California at Berkeley, and Nancy Songer, University of Michigan.

Learning with Ubiquitous Computers. Educational uses of inexpensive computers and interfaces and the impact of every student having ready access to these tools. Directors: Earl Craighill, SRI International, Bob Brodersen, University of California at Berkeley, and Robert Tinker, the Concord Consortium.

Technology and Assessment Models. Issues of assessment of technology-supported education as well as the use of network technologies to support assessment. Directors: Barbara Means, SRI International, and John Bransford, Vanderbilt University.

CILT is poised to undertake critical, interdisciplinary R&D and to be the focus of increased investment in these vital areas. We expect core funding from the National Science Foundation for our first five years and have already had a very encouraging response from leaders of technology industries who could greatly increase the scope of our work. Even with this funding, we cannot support large-scale research projects that we think are necessary. However, CILT provides the only institutional base that could support such projects, should the required level of needed funding become available. And it is urgent that it does. @

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Cool Reviews & Business News

VHS Generates Enthusiasm and Media Attention

by Bruce Droste

A s Director of the Virtual High School™ I recently sent an e-mail to all of the participating teachers asking if they wished to continue in the following year. The message I heard back was loud and clear—Yes!

Here's a sampling of their responses:

•

Bruce, I absolutely DO want to do this again next year. It's the most exciting thing I've done in education in a long time. Absolutely AWESOME. It's incredible to be in the middle of such a cutting-edge project. COUNT ME IN!

•

Wild horses could not pull me away!

•

After all of this work, of course I want to stay on!

•

I definitely will be continuing with VHS for the 98-99 school year. Why just in the months from March-June I've experienced a proverbial 'quantum leap' in exposure to educational technologies. . . . The on screen course construction process has really started me thinking again about curriculum structures in general. You could never get this practical experience in any graduate course.

•

These responses only begin to reflect the level of excitement and commitment of the participants in the VHS collaboration. Thirty brave teachers supported by thirty site coordinators and the Teachers Learning Conference faculty based at Concord Consortium have struggled with "bleeding edge" software—alpha and beta releases—to get their courses ready to run on the first day of school.

Along the way, participants have become tech-

Clockwise, from top, VHS Director Bruce Droste,, U.S. Representative Marty Meehan, Secretary of Education Richard Riley, and Hudson Public Schools Superintendent Sheldon Berman at Washington D.C. meeting in the Rayburn Office Building. Filming Cheryl Davies, Miramonte (CA) High School VHS Site Coordinator, for the PBS "Imagine II Series." Miramonte High School welcomes vitual high school to town.

nological masters. They have digested the many subtle and important techniques that will prove effective with their "virtual students." They have also made new friends all over the country.

Many classes are being highlighted by the news media. After seeing an article about VHS in a California paper, the Public Broadcasing Service "Imagine II Series" spent a day at Miramonte High School in California filming a segment for release this fall (see photo above). The San Jose Mercury News ran a long story that was picked up by the Knight-Ridder news wire. The resulting front page coverage in the Atlanta Journal, the Philadelphia Inquirer and the Denver Post, to name a few, was exciting. Now the cable Sci-Fi Channel is filming segments on VHS in North Carolina and Califor-

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nia for a piece on their weekly news magazine "The New Edge." The New York PBS outlet will film a one hour segment for the weekly "Telecommunications & Information Revolution" series. And the California Teachers Magazine—circulation 300,000—is working on a lead article about VHS.

All this even before school opened! We continue to get calls from television, radio and print media weekly. Obviously VHS has caught the imagination of many people. There are now over 500 students enrolled in the Fall term. The average class size is eighteen. The average number of schools represented per class is ten. The average number of states represented per class is six. Students from Alaska, California, and the country of Jordan are conversing with students from Colorado, New Mexico, and North Carolina, as well as a Department of Defense Dependents School in Germany. A teacher in Massachusetts is instructing students in Ohio, Texas, Pennsylvania, and Washington. From Las Lomas to La Junta, Collingswood to Keystone Oaks, Soldotna to Algonquin, students are learning and communicating with each other online.

"Hi everybody! Is it just me or is this the most fun we've had in a long time," one student wrote to his fellow classmates.

I want to also recognize another powerful collaboration that has happened "behind the scenes" between

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The New York Times
CyberTimes

Directory
AN ADVERTISING MARKETPLACE

December 17, 1996

Signing Up for 'Netcourses' at Virtual High

By PAMELA MENDELS

Without budging from their classrooms in rural Colorado, students from Center Consolidated High School will soon be able to take courses from teachers at Miramonte High School in the San Francisco Bay area, Hudson High School in the suburbs of Boston or a number of other schools around the country.

MIDDLESEX NEWS · SUNDAY, OCTOBER 20, 1996

Hudson High gets wired

Volunteers spend Saturday hooking up to Internet

By George Steeves

Rio Grande SUN, Thursday, March 6, 1997

Program Networks Escalante to Classes

By Maureen Schein
SUN Staff Writer

The Philadelphia Inquirer

tech.life@school

Virtual high school to offer elective courses nationally

Students Eager for Virtual Classes

By Maureen Schein
SUN Staff Writer

Kerry opens Virtual High in Hudson

Releases first portion of $7.4M federal education grant

By Jennifer Kovalich

HUDSON — Riding the information superhighway next fall will make going to school a lot easier for Hudson High School junior Chad Yesue.

Students, teachers move from blackboard to global classroom

LearningSpace: Key to the Future

by Alice Smith and Carla Melucci

Teaching a course over the Internet requires a few components, one of the most important being the medium through which the course is offered. After extensive research of Internet-based training tools, we settled on LearningSpace, developed by Lotus Institute, a division of the Lotus Development Corporation.

Why LearningSpace?

For starters, it has been specifically designed to provide all of the tools and framework necessary to deliver any course over the Web. It is also very easy to use. Once the Virtual High School teachers got the hang of it, they were creating documents left and right. There is no need to learn HTML (Hypertext Markup Language, the language of the Web) or any other program, and it runs on both Macintosh and Windows platforms. LearningSpace is a series of five specialized, interactive Lotus Notes databases that VHS teachers are using to design their courses. We make these databases available over the web via Lotus Domino to the VHS students using their favorite browser.

What are the five databases and how do they work?

The All Important Schedule

The VHS teachers course design begins with the Schedule module. Here is where teachers detail the course requirements, all overview information, and the course activities and assignments, which include student activities, homework, and exams. The Schedule module is the heart of the course, acting as the hub from which all student actions and activities originate.

Keeping Resources Organized: The MediaCenter

Resources that are needed and used for assignments are usually linked from within Schedule documents into other

Main Virtual High School page of LearningSpace on the web.

documents stored in a second module, the MediaCenter. This module acts much like a course library, providing a separate storage place for helpful resources. VHS teachers are incorporating multimedia files, graphics, photos, charts, scanned articles, videos, and sound files. They are taking advantage of LearningSpace's ability to easily accept the familiar and simple two-step process of cutting and pasting graphics directly into documents. With similar ease they are also creating links to interesting educational URLs.

The Activity Area: The CourseRoom

A key element of courses conducted over the web using LearningSpace is interaction between participants. With these exchanges, assignments are clear, students work together, and all those involved have a great opportunity to get to know each other and share information. The CourseRoom module houses two main document types—discussions and work assignments.

Teachers are using discussions in a variety of ways:

• All students are asked to comment with their thoughts and feelings on a specific teacher-posted topic, sharing their knowledge and ideas;

• Students are grouped into teams and asked to research and debate a topic, each student acting in a specific role, posting his or her results to share and/or be graded at the end of the activity;

• Students can post private questions to their teacher on any topic at any time.

To help develop the feeling of camaraderie and connectedness, we've encouraged our teachers to create a discussion thread reserved exclusively for goofing off.

The work area is where students store and work on assignments and projects, alone or with editors or teams. Teachers

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Famine to Feast

VHS Teacher Creates Netcourse from Scratch

Interviewed by Lee McDavid

Teachers in 28 high schools and 11 states are currently teaching netcourses in the Virtual High School project. Louine Teague has designed a netcourse in Geometry which she teaches from her high school in Lumberton, North Carolina. I spoke with her at the beginning of the school year about how she got involved in VHS and how it was going.

Concord Consortium: How did you get involved with the Virtual High School project?

Louine Teague: My principal told everybody at the school that we were going to be part of the Virtual School project and asked if there was anybody who wanted to apply. My first reaction was I'd love to do this but I don't know the technology and I just don't think they're going to teach an old dog new tricks. So I was real hesitant.

I went to a North Carolina Forum meeting where there were representatives from the Concord Consortium back in November of last year. I went to the meeting and I still sort of came away thinking the same thing—I had this little idea of what I wanted to do but I just didn't know about this technology stuff. I'd been out of school a long time.

And so what happened after you applied to teach your course?

Sometime in the end of February I emailed Carla [VHS Program Coordinator] and I said "Haven't heard anything. Who's been accepted?" And she sent me back this letter that said "You have!" I almost panicked. I had a slow computer at home. The school rallied around and worked real hard and got me a computer and got me a telephone line run to my room and did all sorts of things so that I could start taking the TLC [Teachers Learning Conference] course.

Louine Teague, VHS teacher
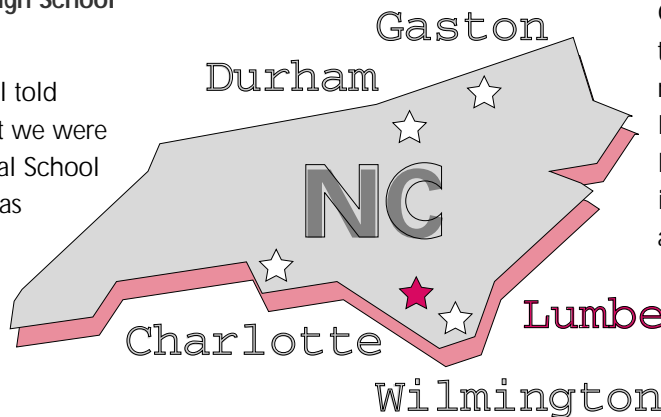
What kind of experience did you have with the Internet before?

The only thing I had ever done was email my daughter in college. That was it. The Virtual High School has pretty much taught me everything I know about the Internet.

And what did you learn?

When I started I had a vision of what I wanted to teach, but I really didn't have a vision of how it could be done. I think that's what I have appreciated the most. Even though it took us some time to get the LearningSpace working, I really think that software is wonderful. One of my favorite lessons was using the 'Net as your virtual library. That let me really for the first time explore the Internet. Other than that I think I had looked up a couple of colleges or two in order to get information for students, and I have looked up Coca Cola because I'm a Coca Cola collector. And other than that I had never even tried to do a search.

You've come so far.

I've put in a lot of time.

You seem to like it, though.

I'm a logical thinker and I'm pretty good at problem solving. I wouldn't be teaching geometry if I wasn't. And it's all logical to me. It makes sense. It's opened a door for me that probably needed to be opened. I had gone back to school and gotten a master's in math education in '90. I'm forty-seven years old. My daughter left for school two years ago. And I've been sitting in the

same classroom for eighteen years. It was time for a change. The Virtual High School came along at a time in my life when I needed something new.

But one of the most important things is the help we've gotten. I feel like I've been constantly supported by the [VHS] staff and by some of the teachers. I feel like those of us who really discussed things from the beginning were the ones who got the most benefit, the training that Concord offered us.

What is the difference between preparing for a regular classroom course and preparing for an online course?

When I first started preparing the [VHS] lessons I had a sense of panic that I wasn't going to be able to get in everything I wanted. Bruce [VHS Director] wrote me back a message one day and he quoted Mark Twain, who had written a really long letter to a friend. At the end of the letter he said 'I would have written you a shorter letter but I didn't have time.'

When you have to be short and concise and to the point, I really think you think through what you are doing much more carefully. Your planning is done much more carefully. You want every minute to count and be valuable. Unfortunately, I think sometimes in the classroom we have our children do what we might call busy work. I have always tried to avoid that, but there's no room for busy work in this course.

But really and truly we won't know how well we've done until we've had a group of students go all the way through.

A page from Teague's online Geometry course.

How do your kids feel about taking a course online?

They're pretty excited. Part of that is because I'm so excited. I have let them know that it's pretty remarkable that here we are in little Lumberton and they're one of maybe 600 students in the nation being exposed to the Virtual High School.

We limited our enrollment to seniors to begin with. They're pretty mature in their attitude. They're going to have a lot of freedom because they'll be in the library working pretty much at their computer, and they'll come to me if there's a problem.

Tell me about Lumberton.

We have about 1,300 students. We are

definitely a low-wealth county. Robinson County has been traditionally tobacco country. Very agricultural. We have probably the most unique situation that you will find in the United States—you can't look at Robinson County and say in the normal sense that there are any minorities. It's almost exactly one-third white, one-third Indian, and one-third Black.

How long have you been there?

I grew up in Lumberton. I went away to college. My husband and I lived away for five or six years and then we moved back here just before my daughter was born. I graduated from this high school. Sitting in my calculus classroom this year I can look out and see four faces that are children of people I graduated from high school with. So I have a very vested interest in the education of these children, more so than I probably would anywhere else, because I feel like a lot of these children are family. @

businees, and the private and public sectors. Every week the programmers at Lotus Development Corporation have listened to reports from our pioneering teachers and the Concord Consortium team about LearningSpace, the program that supports VHS. Lotus has taken our input seriously and repeatedly come up with changes and improvements—sometimes overnight.

Now Lotus has agreed to further support the VHS program. With an influx of over 500 students "hitting" on the VHS server, we needed some heavy server support. Lotus has offered us an Interliant "server farm" in Texas, which means around the clock support and monitoring to prevent "crashes."

To our knowledge Interliant is the biggest and best Lotus Notes support company in the world. This generous gesture allows for greater potential success in the present as well as the future. While presently a research and development project, VHS aims to support schools all over the world in the years ahead. VHS can become a bridge between schools of all sizes, in states and counties with varying resources—an educational opportunity never before imagined.

In the coming months we will all learn what works in the netcourse environment—and what needs fine tuning. For now, let me update a phrase first used by Carla Melucci, VHS Program Coordinator—The Future Is Here! @
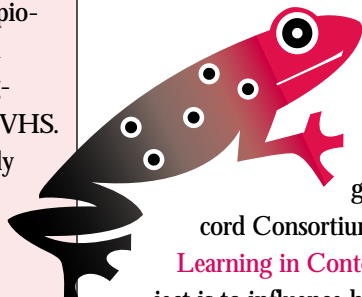
The Jungle Story

Introducing eMate to the Peruvian Rainforest

by Kathryn Costello

One of our goals in the Concord Consortium's Science Learning in Context™ (SLiC) project is to influence how portable technology is used in education. This past summer, while facilitating a series of workshops in which we educated teachers on the procedures for using Apple eMates with probeware in water quality and general science activities, we learned what a school in Noblesville, Indiana, was doing. They had purchased eMates and were interested in using them in a rainforest curriculum. Having recently developed curriculum for the MayaQuest expedition (see @CONCORD, Spring '97), we were fascinated by Noblesville's idea.

As a result, in July I traveled to the Peruvian rainforest near the Rio Yarapa in the Upper Amazon Basin with some educators from Noblesville who, through the Children's Environmental Trust (CET), were traveling to the rain-forest and developing a curriculum that employs the power of portable computing.

We flew into the city of Iquitos, Peru, and took a four hour boat ride up the Amazon towards the Yacumama Lodge, which is located on the Yarapa River—a tributary of the Amazon. This area has been affected by generations of interaction with people. Much of the primary old growth is gone, and faster growing secondary growth—the jungle—has taken its place. As we hiked through the jungle to find primary growth forest, which was a days hike from the lodge, I was struck by the abundance and opportunistic quality of life in the Amazon— the largest continuous rainforest in the entire world.

Tropical rainforests account for less than six percent of the earth's land surface, and yet they contain over half of all life species. Having been untouched by the ice ages, the tropical rainforests are ancient ecosystems which have been developing over tens of millions of years. But they are now being destroyed at a rate of one and a half acres a second—24 hours a day—and the rate of destruction is increasing. If left unchecked it is estimated that these rainforests will be completely destroyed by sometime in the next century.

> **"Technology has the potential to add significantly to students' experience in the rainforest."**

Our guide, Octavio, was a native from one of the tribes near Iquitos. His father was a medicine man, and so he frequently pointed out trees and plants that had medicinal value. Still, amidst the abun-

dance of life, many of the species that dwell in the rainforest have yet to be identified and studied, and their medicinal value has not been realized. The rate of rainforest deforestation may prevent us from discovering those healing potentials and threatens to destroy plants that we now rely upon to cure hundreds of common illnesses, threatening the public health of future generations.

The Yacumama Lodge was a series of small grass roof huts and a main lodge connected by wooden walkways. From here we could hike to elevated wooden platforms built around one of the tallest trees in that part of the jungle. One hot and humid afternoon Brian Crosley from Learning on the Edge and I used an eMate and probeware to test the temperature, light and relative humidity of the rainforest as we all climbed to the top of the canopy. As we climbed the eMate registered a significant increase in light, an increase in temperature, and a decrease in relative humidity.

Later in the week, while torrential rains quickly moved in, Brian watched as his eMate graphed the change in temperature and relative humidity as the storm approached.

In the evening we took a hike through the rainforest and the wildlife sounds were incredible. At one point I tried to isolate the myriad sounds coming from all directions. But it was impossible.

Yet even in this peaceful setting it was

easy to see the effects of increased population and poor land usage. Just a few years ago there were so many fish in the Yarapa River—which at first glance gives the impression that it is too warm and stagnant to support much life—that the keeper of the Yacumama Lodge could tie a net to the dock in the morning and in the afternoon find it full of fish. However, due to over fishing because of greater

The Yucamama Lodge near Iquitos, Peru, is nestled in the midst of the rainforest.

demand by Iquitos fishermen, the area around the lodge and surrounding villages is now nearly depleted.

In Iquitos precious items that have been illegally removed from the rainforest sell openly in the market. Much of the hope of preserving this fragile ecosystem depends upon local villagers who possess the authority to prevent illegal activities. The Yacumama Lodge and CET are developing awareness programs in sustainable development and environmental education geared towards the villagers.

It is a goal of CET to educate young people in our country on rainforest ecology so that they act as advocates for

preservation and make responsible choices as adults. With sufficient planning, technology has the potential to add significantly to students' experience in the rainforest. Like Brian's experience measuring the approaching storm with his eMate, students will be able to instantly create graphs of changing natural phenomena, and they will be able to share their data electronically, both in the rainforest and after they return home to the United States.

Next year, with the help of CET, 35 Noblesville students will travel to the rainforest for one week with teachers, chaperones, and scientists to carry out rainforest studies using eMates and probes. The students are spending the current year preparing for the trip. Next year, after they have traveled to the rainforest, they will spend a year speaking to groups about their experience and may also share their experiences over the Web.

At four-thirty one morning we hiked back to the elevated platform in the rainforest and watched as the sun rose over the top of the jungle canopy. Barely a word was spoken as the dawn spread across the trees. As we watched, we felt the importance of providing the next generation with the tools and knowledge that will inspire them to preserve this magnificent and irreplaceable resource. @

INTEC Reviews Its Current Structure

Changes Bring New Technology, Greater Communication, Broader Approach

by Raymond Rose

The International Netcourse Teacher Enhancement Coalition™ (INTEC) was the Concord Consortium's first netcourse project. Our second netcourse project, the Virtual High School (VHS), started this year. Working with these two projects over the the past year we've learned more about course delivery and associated Web technology from two different directions.

Both INTEC and VHS share the same netcourse philosophy of a scheduled asychronous structure. The general approach is similar to a seminar. Activities are assigned for a particular period of time, but the participants do not have a time when they are required to be on-line. However, the two projects have different goals and hence have different approaches. This provided interesting data for each of the projects.

INTEC is an NSF-funded project providing a graduate-level professional development netcourse for secondary math and science teachers. Its goals are to increase participants' understanding of inquiry and introduce them to educational tools which can be used to incorporate inquiry into classroom instruction. This 125-hour course is delivered primarily over the 'net.

INTEC is investigating the use of netcourses as a substitute for residential professional development institutes— delivering a single course to large numbers of participants—while VHS is creating a cooperative of schools. VHS schools expand the number of courses available through an existing cooperative

> **One of the INTEC goals is developing a community where individuals can support each other.**

wherein individual classroom teachers create their own netcourses and deliver them to classroom-number groups of students. VHS's professional development component prepares VHS teachers to create and teach netcourses.

Recently the INTEC team met to review data and feedback from the current INTEC participants, as well as reaction to the VHS project to date. Based on feedback from participants, our evaluator (Horizon Research, Inc.) and our own reactions, improvements and changes are planned for the next sessions of INTEC.

Which Inquiry?

Inquiry-based instruction has a number of different implementation approaches, ranging from very open-ended to a highly scaffolded (structured) process. INTEC originally positioned itself for a mid-line approach, somewhere between the two polls. But our discussions showed that if we want to provide participants with a better understanding of inquiry we need to allow them opportunities to explore the range of inquiry. So there will now be course activities where participants can explore more open-ended inquiry as well as scaffolded models.

Team-based Approach

The VHS professional development experience was of necessity focused on individual teachers. INTEC has different goals, and the project feedback tells us that the team approach is a significant component in the process. The INTEC schedule includes activities which require the site-based teams to meet together. Our learning to date indicates that there is considerable significant discussion that happens during the face-to-face meeting and then at other times during the school day, for example in the faculty room or lunchroom. One of the INTEC goals is developing a community where individuals can support each other through the process of understanding and testing new instructional approaches.

Graduate Credit Cost

Participants in the INTEC project are able to get graduate credit for participation in the course because we have a relationship with Fitchburg State College

Professional Development

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Increase your knowledge of inquiry- and project-based instruction

International Netcourse Teacher Enhancement Coalition

www.concord.org/intec/

For Information

Call 978-369-4367

INTEC Reviews Structure
continued from page 10

in Massachusetts. They provide graduate credit when a participant successfully completes the course. Since they have increased their tuition this year, so must we. INTEC is currently worth four graduate credits, and costs $240.

Less CalendarTtime

While INTEC remains a 125-hour course, we've redesigned a number of the activities to reduce the overall length of the course. Where it was solidly a three semester long course, it is now possible to complete the full course in two semesters and a few weeks of summer activity. (Since the final set of activities is a practicum with participants doing inquiry in their classroom, the summer activity can't be scheduled as the wrap-up.)

New Technology

INTEC has been using a combination of servers running a hodgepodge of software. VHS has tested Lotus' LearningSpace distributed learning product. INTEC staff feel that LearningSpace matches our needs, and so, at the beginning of January we will transfer to this state-of-the art product.

INTEC has openings for participants in October and January. Any team of four teachers from a site interested in participating in this project should contact Raymond Rose,(ray@concord.org) INTEC Project Director. @

LearningSpace
continued from page 5

can locate work and discussions specifically marked for their attention, and can assign grades if they choose.

Even with a large number of documents and discussions posted and evolving, students can make sense of them all by views. These views, activated by simple button clicks, allow them to sort and select documents by discussions only, by assignments, by teamwork, in addition to other more common orders like by date and author.

Who We Are: Profiles

How can students from 28 schools from around the country get to know each other in the virtual classroom? The Profiles database provides the way. Students can tell each other where they're from, what their interests are, and even provide a picture of themselves.

What Do You Know: The Assessment Manager

This module provides built-in, automatic assessments, grading, and grade book maintenance to assist teachers in appraising their students' performance. Assessment isn't limited to simple test grading, it also allows teachers to evaluate the value of discussion participation, teamwork involvement, and students' progress on work assignments.

The Assessment Manager also provides for other useful tools including the survey, popular with teachers for assorted purposes. Some use surveys to gather information about students, ask their opinions about specific points, or to just ask how things are going, encouraging feedback that they'd normally be able to judge by being in the classroom.

Easy to Start

A course designed in LearningSpace

and presented over the Web doesn't require students to possess special technical skills. They need little more than a basic understanding of how to click on links in a Web browser, a skill many already know or can readily learn in a single sitting. Once into their course site, they are welcomed with a graphical page of module choices, with an inviting "Start Here" icon, making it clear exactly how and where to begin. This action takes students into the Schedule module, which uses either the outline format or a graphical calendar.

Getting Around and Back Again

LearningSpace is easy to use and move around in. Assignments can contain links that take students to multimedia in the MediaCenter, into an on-going discussion in the CourseRoom, or into a new work document. A constant feature of all the modules is a navigator that displays a bar of icons that allow students to easily move from one module to another, and views to sort and select by.

On top of that, each module has its own distinct color that appears within all documents.

Helping Out

LearningSpace comes with a terrific on-line Help, and teachers can also add to it, customizing it specifically to their course. This gives students the special feeling that the Help they read is designed specifically for them, and isn't straight out of the box.

LearningSpace has proven to be a powerful medium for offering courses over the Internet. It's tools and framework are at the same time flexible and comprehensive. @

New Programs and Ideas Anticipate Next Millenium

Reaching Out to Innovative Projects, Goals and Ideas

by Robert Tinker

The Concord Consortium entered a third phase of its development this summer. Back in 1994 we started with a single project, Hands On Physics™ (HOP). A year ago we reached a second phase with four major projects. Now we have matured into an organization where important innovations for the educational use of technology can be supported from basic research through large-scale implementation.
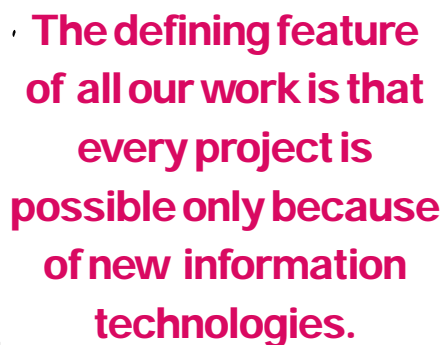
To do this we have created a strong technological core group and expertise in research, curriculum development, pilot testing, and dissemination. In this matrix an innovator can take on a strand of work that might require a decade to complete, obtain funding through various channels, and move that strand along from inception to implementation. Thus, we think of our projects in relation to larger strands of work that go through phases. The following describes these phases and maps where the major strands are currently focused.

Core Technology

The defining feature of all our work is that every project is possible only because of new information technologies. Because our projects draw from advances in technology, we have centralized our technology development and support efforts.

The Technology Group provides the core technologies for all parts of the Concord Consortium, from basic information services to code and hardware development. We provide a T1 line, multiple servers, non-linear video editing, electronics design and prototyping, and software application development. Particular strengths include netcourse server support, embedded micro-controller design, and probe development.

> **The defining feature of all our work is that every project is possible only because of new information technologies.**

Basic Research

Some of the most important advances enabled by technology will come from the new ways we teach and learn with technology. Basic learning research in new technology-rich contexts is needed to explore these opportunities. We are currently investigating three strands of work in this area.

The Center for Innovation in Learning Technologies (CILT). This new, distributed Center (see article, page 1) will provide much-needed leadership in basic, inter-disciplinary educational research and development related to the educational uses of technology.

Models and Representations. This strand of research looks at how to design computer software and real-world interfaces that will help kids think at multiple levels and use mental constructs and models to understand the results of experiments. Understanding may be closely related to the ability to move between mental representations and this ability can be enhanced by interacting with software that captures important features of reality and presents them in ways that can be manipulated and viewed from different perspectives.

Student Inquiry. Technology gives learners tools and access to collaborators and mentors that greatly increase the possible range and depth of their inquiries. Using portable computers and probeware, students in the Student Learning in Context (SLiC) project take these tools to the street, subway, home, or field to investigate questions and phenomena on the spot. Students also join with scientists in a variety of Student Scientist Partnerships that give unique insights about how science works. Kids of all ages can, for instance, build a simple photometer and contribute to the HazeSPAN™ database which will provide scientists with valuable data unavailable any other way.

Innovative Curricula

The spread of computer and networking makes it possible for students to understand new topics that are now too complex or abstract. We have identified three content areas where technologies are particularly valuable in enabling new content that must be part of the curriculum of the next millenium.

Education for Sustainable Future will create, test, and implement technology-enhanced curricula that support sustainable development—increased awareness of the relatedness of phenomena in the natural world, resource limitations, planning for more educated and responsible care and reduced use of limited resources, and decision-making at all levels to implement and evaluate new plans. To appreciate these complex issues, we need a new generation of technology that supports collaborative simulations, modeling, and role-playing.

The International Alliance explores the use of networking to create international collaborations among educators and learners. We are working toward an international curriculum generated by the best educators worldwide, using a variety of technologies to overcome language barriers, with a special focus on international issues that will be increasingly critical for planetary well-being.

Technology Education. The current chasm between vocational and academic education creates unnecessary content and social distinctions that harm young people. We envision a rich mixture of language arts, mathmatical, scientific, and technological subject matter that will help define a new approach to technical education. HOP, by using a technology-enriched project approach, represents a prototype of a range of possible courses.

Pilot Implementations

Once a set of technologies and educational strategies are sufficiently well-developed, they are ready for pilot implementation. Pilots are essential to avoid pitfalls before full-scale implementations are attempted. In large-scale pilot projects, we can work out the kinks and explore the organizational and policy issues that must be addressed prior to larger implementations.

Netcourse Central. Netcourses, complete courses offered over the Internet, are just becoming feasible on a large scale. We are undertaking major pilot tests of netcourses in INTEC and VHS. The INTEC project promises a model for sophisticated teacher professional development at half the cost of competing models. The VHS greatly increases the range and quality of courses available at participating schools by creating low-cost, sustainable school cooperatives that share netcourses. The netcourse idea has important implications to many other areas of education.

Ubiquitous Computing. It is only a few years before Internet access and pocket computers are so inexpensive that every learner and parent have easy access to portable networked computers. This could revolutionize education and permit a wholesale reorganization of the curricula. The technical capacity for this will happen long before we know how to utilize its educational capacity. This strand will study pilot tests of possible large scale changes in schools and communities which ubiquitous computers would support.

Innovative Models. Most instructional models that are currently in use on the Web are relatively direct adaptations of existing educational structures. Are we being blinded by the past and creating the network equivalent of a horseless carriage? Can the technology permit a new design that would have far more learning potential? This strand of work hopes to pilot test novel learning environments, such as NetAdventure™, community-wide learning, and virtual museums.

Dissemination

Our primary work involves pushing the frontier, but we want our research to be expanded and used, so we have organized two strands to get the information out and provide a mechanism for partnerships.

Information Services. This newsletter, our Web pages, and a growing collection of books and reports represent a major effort to share quickly and in depth what we are learning and to provide forums for sharing information in specialized areas such as probeware and netcourses.

Concord Educational Services. We are planning a new effort to provide services based on our R&D. These services are taking the form of workshops, netcourses, consulting, small projects, and commercial ventures.

It is essential that we retain many of the virtues of being small. We plan to do this by creating quasi-independent Centers. It would be a mistake, however, to organize ourselves into the five areas listed above, because any single body of work must be able to move through these phases. Instead, we are creating clusters of strands that have similarities. We now have only one Center, the Educational Technology Lab led by Raymond Rose. We will soon create a Center for Sustainable Futures and an International Center.

This coming decade will see a huge increase in interest in educational technologies. Educators, parents and policy makers will demand research-based content that begins to exploit the revolutionary technologies that are increasingly commonplace. We hope that our combination of Centers and functional orientation will help us produce the needed leadership and give us the institutional flexibility to respond to these demands. @

LINKS ON THIS PAGE
HOP—www.concord.org/proj-hop.html

www.berkeley.edu

Perspective

Addressing the Crisis in Educational R&D

by Robert Tinker

> **" R&D is urgently needed to provide guidance and hard data about how to use technology. "**

Today there is a crisis in research and development in education as a whole, particularly in the area of the applications of technology to education. It is commonly expected that the continued exponential increase of performance in information technology, the huge interest in network technologies, our increasing understanding of cognition, and the widespread concern for educational quality, standards, and technology utilization are combining to make what could be a ten-year educational revolution led by technology.

Unless we greatly increase the research and development effort devoted to exploring new educational paradigms and the technologies that will make them possible, educational change is unlikely. R&D is urgently needed to provide guidance and hard data about how to use technology and what mistakes to avoid. Without it, educators will increasingly wonder what to do with their newly-wired schools. They will regret the huge costs required, and they will be attacked by angry parents who see the unsupported promises of technology unrealized. Legislators will be frustrated about the lack of hard data on which to base multi-billion dollar decisions, and public support will dry up. As a result, unless there are substantial changes, future generations of children will not be fully prepared for their increasingly complex, resource-limited world.

At the same time as more R&D is needed, our current educational R&D community is increasingly unable to address these problems because funding is decreasing. Currently, less than 0.1% of the total spent on education is in R&D, an amount insufficient to adapt to the changes technology causes. Many industries spend a far greater percentage on research. The pharmaceutical industry devotes a whopping 30% of its revenue on R&D, or 300 times as much as education relative to its size. A recent presidential Advisory Committee Report called for educational R&D of $1.5 billion per year.

Current educational R&D in technology consists mostly of individual researchers creating a prototype hardware or software innovation, testing it in some classrooms and turning it into a product. Sometimes that product generates a new line of improved educational technology. My work with Probeware and Paul Horwitz's work with GenScope™ are examples of this kind of R&D. While this sort of research is important, it leaves unexplored too many important questions.

An example of useful R&D would be ongoing projects that work with school districts and colleges to saturate them with computers and networking to see whether familiarity with technological tools supports huge changes in the curriculum. Another example is using probeware and construction experiences in the fourth grade which would to permit the teaching of algebra in the sixth grade and dynamic modeling by the eighth. Primary students could learn about other languages and cultures through international collaborative problem-solving. Middle school students could reenact critical moments in history and the future through online role playing. Upon this broad foundation, we could make huge changes throughout the secondary and tertiary curriculum. Students could grapple with interesting, complex issues like sustainable development. With adequate funding, we could document the student learning and institutional dynamics that facilitated and impeded these changes.

Complex R&D of this sort is out of the question right now. Projects of this scale require hardware no school can currently afford, software that does not exist, funding for at least five years, a huge team of curriculum developers, and an interdisciplinary group of researchers.

I firmly believe that more R&D collaborations like the Center for Innovation in Learning Technologies (see page 1) are needed to understand what works and what doesn't in educational technology. Let's find out before it's too late. @

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Join Us Online

More and Better Probes

The idea of attaching probes to computers burst upon the educational horizon in 1975 when Robert Tinker developed a temperature grapher using the KIM-1 microcomputer. Today, probeware spans heart monitors to carbon dioxide detectors to seismometers to photometers. The list is endless. Since there are so many options and vendors for micro-computer based lab (MBL) probeware and curriculum, the Concord Consortium will be providing a unifying MBL Web location to link all the participants in the field. We hope, with the help of educators and vendors, to make this site a clearinghouse for information, ideas, and reviews of everything related to probeware.

www.concord.org/mbl/links.html

Sustainable Future

The recently coined term "sustainable development" encompasses a group of issues that everyone must understand if we are to create the environmental, economic and social cooperation society needs in the 21st century and beyond. Understanding what sustainability means requires thinking about the complex issues of resource use, allocation, and renewal as well as the responsibility society has to make these resources available to future generations. The Concord Consortium will provide educational, technical, and content expertise to a new sustainable development education project developed and piloted in nine Georgia schools. The Cobb County Public Schools in Georgia will manage the project on behalf of a national consortium of schools, educational innovators, and corporations. Lockheed Martin, BellSouth, AT&T, IBM, the Cobb Chamber of Commerce, and other corporations will contribute substantial human, technical, and financial resources. The K-12 materials developed in the project will be disseminated throughout eight Southern districts through workshops and netcourses, and will be placed on the Web.

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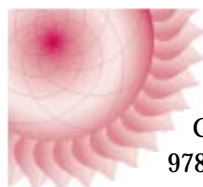
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