Newsletter
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Fall 1998
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INSIDE

Emerging Technologies Meet Educational Need

Forthcoming book describes the success of portable technology in the science classroom

by Kathryn Costello

In 1995, with computers increasing in power and decreasing in size, Robert Tinker, an early developer of microcomputer based laboratories, foresaw the tremendous educational potential of bringing sophisticated portable computers and probeware into the classroom. With funding from the National Science Foundation, he launched the Science Learning in Context (SLiC) project (see Spring 1997, Fall 1997, and Spring 1998 @CONCORD).

SLiC's objective was to develop educational applications for emerging technologies. An underlying assumption was that with proper tools and guidance students learn better in a setting that is relevant to the things they are studying. For example, high school students in Washington studying the water quality of their local river used probes and hand-held computers to collect and instantly view data on the river. This encouraged them to become more actively engaged in the process of data collection and analysis, and the refinement of questions. With their teacher's guidance, they designed a project based on their own observations.

"Science Learning in Context: Ubiquitous Technologies for Learning" is the working title of a book to be published by Plenum Press next year that describes the work that has been done over two years at our test sites in Ann Arbor, Michigan, and Deming, Washington, where teachers have been using portable technology to improve learning in science classes at the middle and high school levels. Co-editors Robert F. Tinker, president of The Concord Consortium, and Joseph Krajcik, a professor in the school of education at the University of Michigan at Ann Arbor, report the final research findings.

A premise of the SLiC project has been that portable technology gives students the opportunity to learn outside of a traditional classroom. Students at our sites have routinely gone "on location" to local

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Science Learning in Context—slic.concord.org
National Science Foundation—www.nsf.gov **Plenum Press**—www.plenum.com

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Educational Technology Lab

Editor
Robert F. Tinker

Managing Editor
Lee McDavid

Contributors
Stephen Bannasch, Kristin Barr, Anne Bijur, Edward Burke, Jack Byrne, Mary Ann Christie, Kathryn Costello, George Collison, Marie Dokoupil, Bruce Droste, Donald Eastlake, Noah Fields, Jeannie Finks, Storie Frost, Sarah Haavind, Paul Horwitz, Paul Keefe, Joanna Lu, Cynthia McIntyre, Shea McGovern, Carla Melucci, Shari Jackson Metcalf, Bob Miner, Allen Parker, David Pitkin, Raymond Rose, Joyce Schwartz, Robin Sebesta, Alice Smith, Carolyn Staudt, Barbara Tinker, Dick Walton, Keith Wheeler

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The Concord Consortium
37 Thoreau Street, Concord, MA 01742
(978) 369-4367, FAX (978) 371-0696
info@concord.org
http://www.concord.org

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Meet the Board

Our six-member Board of Directors is a diverse association of dedicated and successful professionals committed to expanding educational opportunities worldwide. The next few issues of @CONCORD will feature our board members and their interests. More detailed information is available at our web site.

Goéry Delacôte *was recently profiled in the September 26, 1998, issue of* Science. *As Executive Director of San Francisco's Exploratorium, he heads one of the finest and most innovative science museums anywhere. Upon the death of the Exploratorium's founder and longtime director, Frank Oppenheimer, Goéry took on the challenging job of leading this successful organization and giving it a vision and mission within an information-rich future. As a French physicist he brings content, an international perspective, and a deep understanding of learning to our Board of Directors.*

Penny Noyce *is co-principal investigator of the National Science Foundation's Systemic Initiative Projects in Massachusetts, including the PALMS project (Partnerships Advancing the Learning of Mathematics and Science). A practicing internist, she is also a Trustee of the Robert Noyce Foundation, which honors her father, one of the founders of Intel. Her opinions on school reform in math and science were published in the July 12, 1998, edition of the* Boston Globe. *Her expertise as a physician, educational activist, and funder, contributes to our work in many important ways.*

Emerging Technologies

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rivers and lakes to study environmental issues, such as the effects of pollution on a local watershed, the consequences of increased pollution on lakes, and declining salmon populations in the Pacific Northwest. Students do "real" science in a supportive context.

As a result, students developed firsthand knowledge of issues in their communities and got excited about science. Older students worked on sophisticated research projects where they forged valuable alliances with state, industry, and other agencies. Explains Nathan Brouwer, "This experience of doing field work using portable technology has made a real impact on my life. I plan to major in field biology, and do field science research." This past summer Nathan worked with Knowledge Revolution writing experimental activities for the Apple eMate.™

Roxanne Badillo, a student taking part in the salmon project, said, "This kind of science is very valuable. You get to do field work outside the classroom. Get to know your teacher. Your teacher gets to know you. It's actually fun."

Teachers at each of the two sites contributed chapters to the book. They describe how the SLiC project worked in their classes and give examples of how students worked in groups and on individual projects. "Science Learning in Context" looks at the experiences of an elementary level math class using portable technology to study velocity and distance, and show how educators can integrate technologies into their classrooms.

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Board of Directors—www.concord.org/about/board.html
Intel—www.intel.com
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Knowledge Revolution—www.krev.com
PALMS—www.doe.mass.edu/palms

The Virtual Meeting

Symposium software points to wider communication online

by Raymond Rose

Symposium™, a product of Centra Software, Inc., in 1988 won New Media magazine's Hyper Award for Online Training Software. Symposium was the first software-only system for the integrated delivery and management of live, instructor-led training with self-paced learning and communications across the Internet.

We tried out Symposium on International Waters:LEARN, a technical assistance project implemented by the United Nations Development Programme and the Global Environmental Facility, to create a shared knowledge base and wider communication between a growing number of international waters projects. The core objective of the project is a three-year plan to test delivery of Internet-based products at 20-25 international sites. The products include audio conferencing, telemeetings, online knowledge bases, online seminars, netcourses, a distance-delivered master's degree program, virtual scientific meetings, and linking of coastal schools.

Teleconferencing

Symposium was a logical product with which to experiment. It combines audio conferencing, live application sharing, a collaborative whiteboard, breakout sessions, computer-based training, web tours, and threaded discussion forums into a comprehensive, content-neutral learning environment. However, we only used a small subset of these features. We focused on the live online conference session.

As a teleconferencing tool, Symposium performed admirably. The participants were able to communicate easily with each other. The audio quality was as good as a telephone conference, and we were able to know that everyone was looking at the same materials at the same time. The critical success factor was the audio capacity of each user's system, which required good quality audio components (audio card, microphone, and preferably a headset). We tuned our audio system with Windows 95 utilities and then, after installation, with Symposium's Audio Wizard. But we found that some systems required no special tuning, while others required extensive tuning.

Midway through the test, we encountered problems when the Symposium client suddenly stopped working on one of our computers. Our Tech Support worked for a long time trying to identify the problem, and it turned out to be the computer's updated the web browser. During its installation a new version of the JVM (Java Virtual Machine) software had been installed which conflicted with our Symposium client. We solved the problem by installing the latest version of Symposium.

Centra has not announced plans for a Macintosh client, so Macintosh users will have to wait. But Windows clients can install Symposium today.

Server Hardware and Software

The Symposium server software runs on a dedicated computer. A dual-processor, high-speed Pentium box with large quantities of memory makes a suitable server. The server software is only available for the NT platform, but a UNIX version may be available in the future.

The server needs to be located on an Internet connection with substantial bandwidth available to support a reasonable number of simultaneous connections. Initial tests during the IW:LEARN meeting happened over our T1 line, a level of bandwidth not necessary for the small number of users in the meeting. But it is clear that a 56 kbs modem connection would have been unacceptable.

The server design proved to be robust. During our teleconference, which included participants from Massachusetts, New York, Washington, D.C., Canada, England and Australia, the leader's computer in Concord, Massachusetts, crashed and had to be rebooted. (The crash had nothing to do with the Symposium client.) But even with the instructor's computer offline, none of the other connections were lost. Participants drew on the shared whiteboard and chatted with each other, just like students do when the teacher leaves the classroom for a while. The teleconference resumed as soon as the leader returned.

User Interface Design

Symposium's instructor interface is different from the student interface. The instructor interface has a number of busy windows to manage, and more than one piece of information can flow within some windows. During our test, the instructor had to periodically check with students to make sure everyone was looking at the same thing. One way to help an inexperienced instructor would be to place a computer displaying the student interface in the same room with the instructor.

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United National Development Programme—www.undp.org
Symposium—www.centra.com/product/index.html
Global Environmental Facility—www.gefweb.org
Centra Software—www.centra.com
New Media—www.newmedia.com

Virtual Ink and Transcontinental Writing Students

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by John Kendall

Students often fear receiving essays back because the traditional red ink from many corrections makes it seem as though their papers are "bleeding." As a writing teacher, I've always preferred using green ink, an organic, "growing" shade. Despite all the improvements technology has provided for beginning writers, from word processors to spell checkers, they will always need human teachers to "grow" and not simply to "bleed." But do student and teacher need to be face-to-face? I tested this theory when I applied to teach a class in the Virtual High School's first year of operation. Sponsored by The Concord Consortium and the Hudson public schools in Massachusetts, VHS is an experimental, online school with members from about thirty traditional schools in four countries. For every VHS class a member school offers, VHS allows up to twenty students from that school to take courses over the Internet.

I chose to teach a classic expository writing format to verify a long-standing belief that writers should be judged by their efforts to formulate thoughts clearly on paper (substitute "screen"); by their ability to revise, through feedback from the teacher and peer editors (via e-mail and within the Netscape course); and by the skill of the final draft. Although I'd prefer face-to-face, daily contact, I wanted to try to communicate only through printed words and to interact with students from afar, in this case California, Washington, North Carolina, Massachusetts and Ohio—all without leaving the Rutgers Preparatory School (New Jersey).

One of the toughest aspects of "virtual teaching" is that you have to write everything down—from the detailed outline of the course to "off the cuff" comments. Although I've taught for nearly twenty-five years (mostly writing courses), I had never realized how much "off the cuff" instruction occurs separate from the official course of study. But the Lotus Notes™ software helped. It enabled me to structure a schedule, to design an area for discussion questions about the readings from the essay anthology, and to provide private areas where each student could confer with me or a peer editor privately. There were also some adjustments for the students. They had to read and follow directions without me being there in person to answer questions and clarify confusion. They also had to motivate themselves to participate in class without a bell ringing or an adult shooing them into a physical room.

That said, I think teaching in a virtual environment offered distinct advantages to counteract the unquestioned strengths of flesh and blood contact. Because we had to type every word, to send it electronically, I could take advantage of Lotus Notes' sixteen-color text palette. My personal notes glowed in dark green; important reminders appeared in purple; and the private conference area displayed a rainbow of color-coded progress reports. My best serious use of colors was to mark punctuation mistakes on final drafts in one color, questionable syntax in another color, positive remarks or neutral questions in a third color, and so on. Because peer editors could use a private area to remain confidential in assessing rough drafts, student writers could take risks more freely and respond to the positive support of teacher and student feedback.

With asynchronous time, no 3:00 bells exist. A week's worth of classes started Wednesday morning and finished the following Tuesday midnight, but we never met altogether at a specific time. Students did have to post work on specific days and had to meet deadlines, especially when peer editing, but did not have to attend writing class "first period." Some worked during an assigned lab period at school, but others preferred a more leisurely pace after school and quite a number worked at home, late at night or on the weekend. Students established their own habits. As Dom observed, after posting a reply from California, "How many people normally sit in your English classroom at 2:30 a.m. on Saturday morning?" Although we had a few "technical blizzards," in the first few weeks, no snow days prevented students from submitting work.

In fact, the Virtual High School's greatest appeal may be that students earn grades based on merit, to a far greater degree than even the scrupulously fair teacher might assume possible in a physical classroom. People were not tall or a

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Virtual High School—vhs.concord.org

Lotus Notes—www.notes.net

Rutgers Preparatory School—www.ifu.net/~rutgers particular skin color or "attractive," and no one talked with a foreign accent, or a Southern drawl or an East Coast staccato. I graded them on the response to the assignments, on how they expressed their thoughts in their writing, and their ability to meet deadlines and interact with their peers. I am embarrassed to admit that for almost four weeks, because one girl had an unfamiliar first name, I didn't realize she was a she. Upon further reflection, I decided that it wasn't such a horrible mistake after all. I literally had been "gender blind."

I also found that geographic distance supplies energy and fresh audiences. Jeff's description of a hike through the icy New England woods with his father brought the same sensory rush as Aaron's mountain biking and swimming experiences in the "Devil's Punchbowl" in northwest Washington. Dom's casual question, "What's sleet like?" or her mentioning that she was going to school in a tank top and cut-offs in December amused and infuriated Sara, as 18 inches of Massachusetts snow slowly buried her school. Other writings only reminded us how universal and constant human behavior and emotions are, from Lisa's description of teenagers skinny dipping in California to Kelly's account of a student caught shoplifting in Disney World. Dom portrayed an eccentric and lovable teacher who could have been managing a class on either coast, just as both Chris and Jim captured the triumphs and agonies of earning a football championship in Ohio and struggling to recover from injuries from that same sport. There's the hard stuff, too. A marriage dissolved. An out-of-control former boyfriend stalked his ex-girlfriend. And a friend's drug overdose inspired one writer's non-generic warning about speed.

My students wrote about a world so real and tangible, I would emerge from their final drafts "geographically disarrayed." I would look out the window to see the Rutgers Prep campus, to remind myself I still sat in a small independent school in New Jersey.

Virtual schools can work. It's still teachers and students interacting, however sophisticated the technology. As Dom noted, "It was still high school. We just didn't have a seating chart or bologna sandwiches sticking open-faced to the ceilings of the hallway."

In a way, I think writing to fellow students whom you don't see prompts greater honesty, like confessing your deepest secrets to the person sitting next to you on a plane. Perhaps students brave and strong enough to share their stories and perfect their craft don't need physical classrooms, so much as they need supportive peers, diverse audiences and attentive teachers. @

John Kendall teaches English at Rutgers Preparatory School in New Jersey. He thanks Dom Brassey and Lisa Brazie for their editing.

VHS Takes On 50 New Schools In 1999-2000

by Carla Melucci

As we begin the third year of the Virtual High School, the level of interest and excitement VHS has created in teachers, principals, superintendents, and other high school administrators keeps growing.

In Year One, we trained 32 teachers from 27 high schools and one college. In Year Two, those teachers went on to teach over 500 VHS students, while we were simultaneously training 13 additional teachers. Five of these trainees were teachers from founding schools, seven were teachers from new schools, and one was from a local college.

This past spring, a Year Three recruitment effort brought an overwhelming response. Regional representatives from Massachusetts and Ohio held workshops to generate interest within their states and a Texas Site Coordinator held workshops and attended meetings to promote VHS in the Lone Star State. In the meantime, VHS national office staff attended conferences, mailed out informational packets and answered inquiries.

As a result, we received over 80 applications from around the country. Sixty teachers from 50 new schools were accepted and began training this fall. The majority of new schools are from Massachusetts and Ohio. The rest come from California, Colorado, Minnesota, North Carolina, New Jersey, Pennsylvania, Texas, Vermont and Virginia.

Although we are no longer accepting applications for the 1999-2000 academic year, if you are interested in joining the Virtual High School for the 2000-2001 year, please visit our web site. @

Carla Melucci is Project Coordinator for the Virtual High School.

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

Mobile Computing Accelerates Learning

Portables improve math and science performance

by Carolyn Staudt

Teachers lack the time, technical expertise, or subject matter background to fully exploit the potential of portable computing. Without lesson plans, guides to integration, and teacher professional development materials, the dream of integrating technology into every classroom cannot be achieved.

The Mobile Inquiry Technology project promises to radically alter this reality.

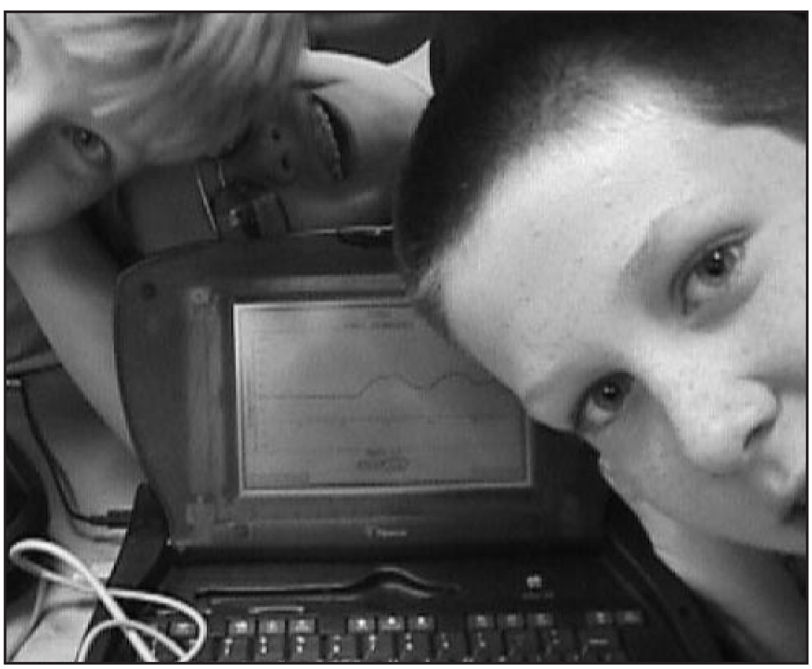
In the fall of 1997, the Hudson Public Schools, in collaboration with The Concord Consortium, began a small scale experiment in the use of a class set of small portable computers to enhance math and science activities in a fifth grade classroom. For example, students used the portable computers to record data and transform it into charts and graphs. We found that student understanding of math and science concepts accelerated. This instantaneous transformation and visualization ability advanced their understanding of data interpretation and the relationship between raw data and graphic interpretation.

This initial pilot project gave us the confidence to create a statewide technology project for the implementation of the math and science frameworks. As a result, in the spring of 1998, the Massachusetts Department of Education awarded a consortium of four Massachusetts schools, led by Hudson Public Schools and The Concord Consortium, a Technology Literacy Challenge Grant to develop important new ways of integrating computers and networking into elementary and middle school mathematics and science learning and to disseminate these strategies statewide.

The one-computer classroom and the computer lab models of providing student access to computers have been plagued by the simple problem of not enough equipment. These models do not allow students the in-depth, continuous experience with computer technology that they need. In addition, as the world of business and research shifts to mobile equipment that is transferable and flexible, education continues to be burdened by computers that are bolted to desks or, at best, on a moveable cart.

Often teachers cannot integrate computer technology fully into their curriculum because they cannot count on frequent equipment availability. New mobile computers dramatically open up the possibility of every student having access to technology and every teacher being able to fully utilize technology's instructional potential.

The one-computer classroom has been plagued by the simple problem of not enough equipment.



Mobile technology is important for many reasons. Manufacturers are exploiting new, powerful technology to reduce the price of computers so that schools can provide students with class sets of mobile computers. Reduced cost means schools will be able to provide students with regular and consistent access to computers so they can become competent in keyboarding, facile with the computer conventions, and masterful with complex applications within the context of regular school work.

LINKS ON THIS PAGE

Technology Literacy Challenge Grant—info.doe.mass.edu/edtech/MTLCes.html

Massachusetts Department of Education—www.doe.mass.edu

Hudson Public Schools—www.hudson.k12.ma.us

The portability of these new computers allows learning to occur anywhere and anytime—on the bus, in the field, at home, or on a trip—so that students can ask, investigate, and answer questions in the contexts about which they are learning. Software and scientific probes present an integrated set of tools for writing, experimenting, calculating, graphing, communicating, and collecting data. With the addition of probes that test for motion, conductivity, current, dissolved oxygen, illumination, pH, temperature and more, these tools have the power and flexibility to support a wide range of student inquiry.

New low-cost, modest performance portable computers designed for education have no moving parts to break. Instead of using a hard disk, they rely on flash RAM and easy communication with a host computer. As a result, they are tough enough to be dropped onto concrete and tossed into a student's backpack.

Eliminating the disk drive gives it low weight, long battery life, and instant resume after sleep. Our 1997 pilot project in Hudson Public Schools was designed around the Apple eMate™. The eMate has a touch screen which serves the role of a mouse or drawing pad but is easier to learn and use. It uses the Apple Newton handwriting recognition, but also has a keyboard, and comes with software for word processing, drawing, spreadsheet layout, and graphing equations. (Apple is presently redesigning its portable computers, so eMate will not be used during the first year of the project. Students will use Macintosh portable laptops that also allow students to work in the field and to investigate in many contexts. By the end of the project students and teachers will be prepared to use the new generation of eMates as well as computers developed by other educational computer companies.)

The heart of the project is to seamlessly integrate new, portable technology with new math and science curricula by developing collaborative research activities that utilize the full capability of the equipment. In this way, we can integrate technology into the excellent inquiry-based approaches to mathematics and science that have been identified in the Curriculum Frameworks and are being promoted in Massachusetts by PALMS, CESAME and others.

At The Concord Consortium we will use our expertise concerning effective computer-based education to create inquiry-based materials that are practical, classroom-tested, interesting, and appropriate for a range of students. Outstanding teachers in Hudson, Shrewsbury, Northborough-Southborough and Westborough, Massachusetts, Public School Districts will test the materials. Within 18 months a set of materials will be completed that meet the new math and science frameworks and are ready for dissemination statewide.

The Mobile Inquiry Technology project will provide an activity guide for computer-based field study and applied research activities for 4th through 6th grade. The curricula will be tied to the basic topical units from such exemplary math and science curricula as Full Option Science System; Insights; Science and Technology for Children; Everyday Mathematics; Investigation in Number, Data, and Space; Mathland; and the Connected Mathematics Program.

The project will also develop a teacher's guide on mobile computing and scientific probes that will contain sections on applying these tools to inquiry math and science and managing their operation in the classroom and field. It will also cover mobile computing as a model for classroom technology use.

Through the use of the curricula, model classrooms in all four school districts will demonstrate effective classroom use of class sets of mobile computers. In addition, they will have regular and ongoing access to a set of scientific probes.

New low-cost portable computers are tough enough to be dropped onto concrete and tossed into a student's backpack.

Finally, this project will create a leadership network that enables school districts throughout Massachusetts to make effective use of a new generation of portable computers to improve math and science education in the elementary and middle grades. @

Carolyn Staudt is a curriculum developer at The Concord Consortium.
carolyn@concord.org

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eMate—www.apple.com/emate
Newton—www.newton.apple.com
PALMS—www.doe.mass.edu/palms
CESAME—el-nino.ur.neu.edu/cesame

Monda

A Tale of Cub
Things to do wi

by Pa

So, I'm at this boring lecture, and I make this great discovery, namely that 1 plus 8 equals 9. Oh, so you already knew that? But did you also know that 1 and 8 are perfect cubes and 9 is a perfect square?

$$1 = 1 \times 1 \times 1 = 1^3$$
$$8 = 2 \times 2 \times 2 = 2^3$$
$$9 = 3 \times 3 = 3^2$$

OK, maybe you knew that too, but wait, as they say, "There's more!" I discover that $1^3 + 2^3 = 3^2$.

Now I'm wondering, if the sum of the first two perfect cubes equals a perfect square, what does $1^3 + 2^3 + 3^3$ equal? It turns out that it also equals a perfect square—

$$1^3 + 2^3 + 3^3 = 6^2$$

It begins to look like I'm onto a pattern. No doubt Euclid and his pals knew all about this stuff, but still it's new to me and that makes it a discovery any way you look at it. I fish a scrap of paper out of my pocket and start adding cubes of the numbers from 1 to 4, 5 and 6, and lo and behold, I get more perfect squares—

$$1^3 + 2^3 + 3^3 + 4^3 = 10^2$$
$$1^3 + 2^3 + 3^3 + 4^3 + 5^3 = 15^2$$
$$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 = 21^2$$

All this time, the speaker is going on about how the kids in Israel did better than U.S. kids on an international math test, which is pretty important, I guess, but I'm not listening too closely because I'm figuring there's got to be a formula here.

Let's see, the sum of the cubes from 1 to 2 is 3 squared; the sum of the cubes from 1 to 3 is 6 squared. Take a look at my calculations below and then in the table.

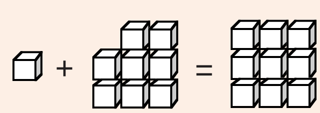
$$(1+ 2) = 3$$
$$(1 + 2 + 3) = 6$$
$$(1 + 2 + 3 + 4) = 10$$
$$(1 + 2 + 3 + 4 + 5) = 15$$
$$(1 + 2 + 3 + 4 + 5 + 6) = 21$$

TA

Sum the cubes from 1 to . . .	**Cube the numbers up to n, then add them.**	*The*
1	1^3	
2	$1^3 + 2^3$	
3	$1^3 + 2^3 + 3^3$	
4	$1^3 + 2^3 + 3^3 + 4^3$	
5	$1^3 + 2^3 + 3^3 + 4^3 + 5^3$	
6	$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3$	

I'm thinking, "If only I had a spreadsheet I could check this out all the way." But I've left my computer in my hotel room. Still, I'm pretty sure it's going to work, now the question is, can I prove it?

So I try making a picture with imaginary tiles. In an obvious representation, I can show my first "discovery" that 1 plus 8 equals 9.



1 + 8 = 9

; Lesson

and Squares:
bathroom tiles

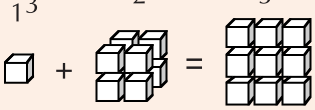
orwitz

E

ual!		Add the numbers up to n, then square that number.	Square the sum from 1 to . . .
1	=	1^2	1
9	=	$(1 + 2)^2$	2
36	=	$(1 + 2 + 3)^2$	3
00	=	$(1 + 2 + 3 + 4)^2$	4
25	=	$(1 + 2 + 3 + 4 + 5)^2$	5
41	=	$(1 + 2 + 3 + 4 + 5 + 6)^2$	6

Shown this way, one interesting fact that I discover is that the tiles that make up the odd-shaped piece that represents 8 can be rearranged. Try moving the tiles around in your head. What happens to the odd-shaped piece? You've got it! The tiles can be rearranged into a perfect 2 x 2 x 2 cube.

$1^3 \quad 2^3 \quad 3^2$



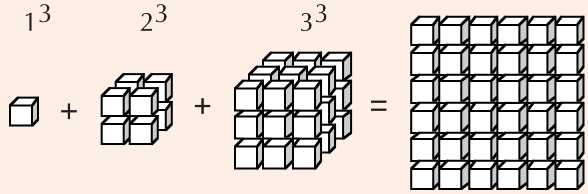
$1 + 8 = 9$

The question is, does this relationship continue? If you go from this square in the sequence to the next, will the tiles form cubes?

Let's see how things work out with the 6 X 6 square.

Imagine moving the tiles around in your head again. If that's hard, use blocks or something else stackable. What shapes do you get? Voila! The same number of tiles in your 6 x 6 square can be rearranged into cubes, just as our table shows.

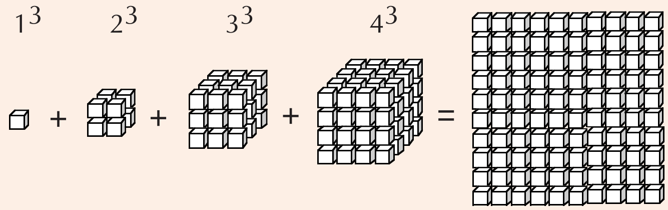
$1^3 \quad 2^3 \quad 3^3 \quad 6^2$



$1 + 8 + 27 = 36$

The next square in the series is the 10 X 10 and yet again the tiles break up nicely into cubes:

$1^3 \quad 2^3 \quad 3^3 \quad 4^3 \quad 10^2$



$1 + 8 + 27 + 64 = 100$

It works!

This kind of thing keeps happening as long as the numbers are integers. Try it out with the 15 x 15 and the 21 x 21 squares. You'll see that the pieces come apart neatly to rearrange into the required number of cubes.

Like magic!

The lecture comes to an end and the U.S. kids are still hopelessly behind, but I don't really notice—I'm too excited about cubes and squares. @

Paul Horwitz is the Director of the Modeling Center at The Concord Consortium. He is also Senior Scientist for the GenScope and BioLogica projects.

Virtual Meeting

continued from page 3

Having an additional person to assist the instructor provides another set of eyes and ears to help monitor all the various messages and inputs, and can serve as an instructor training strategy.

The student interface is also busy. There are a number of ways for a student to contact the instructor or have private conversations with other participants. This can be confusing. Providing a place where instructions and window management are explained would be useful, if not mandatory, for ensuring a successful online experience.

To our knowledge, there is no manual on how to develop a strong online course or meeting. The technology is so new that the most effective practices are still being created. We found that meeting or course objectives need to be thought out in advance and procedural rules should be developed (e.g., use of yes/no voting and buttons, pacing, and the chat screen). It is important to develop and plan the sequence and structure for any online activity. In this medium, the instructor's directions can make the difference between a successful or a very frustrating experience.

For us, Symposium proved to be a good option for online meetings. We need more experience before we can comment on using it as an instructional tool. One caveat—though it looks like anyone could sit in front of a computer and hold an online meeting, it should not be undertaken casually, no matter what technology is used. Planning and preparation—which area essential to ensuring an effective experience for everyone—are essential to any online activity. @

Raymond Rose is the Director of the Educational Technology Lab.
ray@concord.org

GOOD ADVICE

- **The efficiency and effectiveness of online activities are best when the instructor has taken the time to become thoroughly familiar with the user interface for both the instructor and the student. Given the rich set of options Symposium has, an instructor needs to devote a significant amount of time becoming familiar with the numerous tools and the relative strengths of each tool.**
- **Because audio communication is potentially of such high quality, an instructor can be seduced into using the audio tools without incorporating other aspects of the software that require more involvement from the participants. An online activity that only uses audio could end up being no better than a bad lecture. Event design needs to consider a variety of learning styles, which necessitates the use of more than one Symposium tool.**
- **Good design of the instructor materials is not a trivial consideration. Page length should be restricted to a screen. Confusion can result when the instructor and student are looking at different segments of a long page. Links between pages need to be carefully thought out for both linear and nonlinear presentations.**
- **Each session's objectives should be limited in order to keep the session down to a reasonable time. It is not reasonable to expect that the instructor immediately will have the skills to cover the same amount of materials online as might be covered in the classroom in the equivalent amount of time. But as users become familiar with the whole array of Symposium tools, it is likely that the efficiency of the online medium will exceed the face-to-face meeting. Long online sessions are not a good idea. While there is no technical limitation to the length of a Symposium session, a good rule of thumb would be to keep the time below 90 minutes.**
- **Asynchronous tools such as listservs, threaded discussions, and web pages should be used to support the online activities. Symposium has asynchronous tools for this very purpose. Pre-event readings and post-event discussions are just two simple examples for extending the time devoted to any objective.**
- **The centerpiece of our experiment was the synchronous event. We used asynchronous activities for pre-event preparation. Another approach is to use synchronous activities as the lead-in to an asynchronous event, which could significantly change the nature of the communications.**

See also *Group Computing* (July/Aug 1998) or *PC Week* (Aug 10, 1998) for a review of Symposium, LearningSpace, and other virtual meeting software.

LINKS ON THIS PAGE

PC Week—www.pcweek.com
Symposium—www.centra.com/product/index.html
Group Computing—www.groupcomputing.com
LearningSpace—www.lotus.com/learningspace

The Virtual Classroom

November 1998
Shelburne Farms, Vermont

The classroom of the future is here today!

Learn from the experts during two introductory workshops on teaching and learning in the virtual classroom. Workshops will be held at the beautiful and historic Shelburne Farms, close to the Burlington International Airport in Burlington, Vermont, and site of our Center for a Sustainable Future. Continental breakfast, lunch and all materials are provided daily. The Concord Consortium has been internationally recognized for its work in creating powerful and innovative online learning environments. Join us for an informative week that could change your teaching style forever.

Online Moderating: Supporting Learning in Virtual Communities

November 2-3

The learning that takes place in online discussion groups critically depends on the skills of the group leader, or moderator. Restrained but effective intervention can be critical for guiding group learning. This workshop is based on our experience moderating online teacher professional development courses.

In this workshop you will learn—

- How to foster learning via virtual discussion.
- Successful strategies for voice, style, and questioning.
- How to guide the group learning process.
- How to deepen the online dialogue.

Developing Online Training & Instruction: An Overview of Technology & Pedagogy

November 4-6

Distance learning, distributed learning, netcourses, online education, Web-based education, virtual courses—learn about the classroom of the future during this three-day concentrated investigation into the growing field of Internet-based education.

In this workshop you receive—

- An overview of the tools currently available for delivering online education.
- An understanding of netcourse pedagogy.
- An understanding of the issues surrounding creating and teaching a course on the Internet.

Information 978-369-4367
http://ccservices.concord.org/workshops
info@concord.org

REGISTRATION

Name (print) ____________________

Address ____________________

City ____________________ State ____________ Zip ____________

E-mail ____________________

Home Phone ____________________ Work Phone ____________________

Payment Enclosed: (circle one) $475 (Developing Online Moderation Skills, Nov 2-3)

$695 (Developing Online Netcourses, Nov 4-6)

$999 (both courses, Nov 2-6)

Enrollment Limited

Register by Oct 21

Mail check payable to:

The Concord Consortium
CC Services, 37 Thoreau Street, Concord, MA 01742

Lost Your Marbles?

We know someone who can help — a behind the scenes look at how vendors help us assemble an INTEC netcourse

by Cynthia McIntyre

Tell her that I found her marbles," the clerk at the West Concord Five and Ten laughed over the telephone one afternoon.

It might have been the beginning of a crank call or a bad joke. But I understood about the marbles, and I needed plenty of them—enough to supply 600 teachers who would be doing a crater-making experiment from the book *Craters!* The Five and Ten not only sold us enough marbles to make any seven-year-old from the '50s dizzy, they repackaged the marbles for us into ziplock bags. On top of that, they gave us a price discount.

The generosity (and humor) of the West Concord Five and Ten is just one example of how local vendors, along with national corporations, provide supplies for our International Netcourse Teacher Enhancement Coalition (INTEC), funded in part by the National Science Foundation.

INTEC assembles materials from businesses as diverse as the Five and Ten and NASA in order to supply middle and high school math and science teachers with the materials they need to complete a two-semester graduate netcourse (a course provided online). All of the materials gathered—everything from marbles, hot cocoa, clay and cardboard to books, software and videos—the project provides to participants at no cost.

INTEC is all about bringing inquiry into the classroom—a learning process that uses student investigation and active questioning to build conceptual understanding beyond memorization.

We offer a unique hybrid model for a professional development netcourse. Much of the work is done online, through web pages and in discussion areas, but equally important are the local study group meetings. Here is where team members at a site, comprised of four or more teachers or administrators in the same school or building, meet on a regular basis to do a hands-on unit, like dropping marbles to simulate making surface craters.

We chose the National Science Teachers Association book *Craters!* (offered to us at a 25% discount) because it provides many inquiry experiences. Over the course of the year participants experience inquiry for themselves through the materials we assemble for their use.

Hot chocolate is another part of our project. We use it to simulate a planetary surface made of a white flour subsurface and a cocoa surface—a baker's dream, if not a viable habitat—and impacting it with marbles which act like falling bodies in our make-believe universe (see "Create a Crater" on page 13). When I explained the project to Crosby's Market in Concord they sold us 100 boxes of cocoa at a dollar a box. "Let's make the price an even number," I suggested. The manager agreed and threw in a 10% discount as a contribution.

NSF requires INTEC to partially support itself with in-kind contributions, so a discount on materials we use for the hands-on part of INTEC is welcome assistance. So is tracking down unusual materials.

Plasticene clay for an activity was supplied by a graphic arts company, Charrette, in Cambridge, Massachusetts. Going from the unusual to the ordinary, a local printshop, Alphagraphics, gave us a significant price cut on cardboard, used in another activity involving modeling lunar craters.

INTEC introduces participants to inquiry instruction through an examination of their own classroom practice. What is inquiry? Is it important? If so, how important? Is it worth the classroom time? Can I use it all of the time, some of the time? These are just some of the questions we probe at the outset of the course and continue to examine through an introduction and five topics. Participants work through an introduction to the Web and use an online discussion area where they introduce themselves to their colleagues, who might be in the next classroom or the next country. (We have participants from the U.S. and Canada. Our first cohort had members from Australia.) Online participation is augmented by local study group meetings. Each step of the way, INTEC provides materials that are meant to help the participants experience and understand inquiry.

In the first topic, "Pedagogy in Support of Inquiry," participants gain a conceptual understanding of the impor-

LINKS ON THIS PAGE

INTEC—intec.concord.org
Domino—www.lotus.com
Charrette—www.charrette.com
National Science Teachers Association—www.nsta.org
Alphagraphics—www.alphagraphics.com
Craters!—www.nsta.org/scistore
NSF—www.nsf.gov

tance of inquiry instruction. The Annenberg/CPB Math and Science Project offered us a 10% discount on the videotape “Private Universe” to use for the course. Participants watch teachers like themselves and their students in the film, which leads to a discussion of inquiry instruction. Teachers also use conceptual probes on the Web and ask their students to use them as well. Questions like “Where does the mass of this log come from?” examine conceptual understanding and misunderstanding.

The second topic, “Personal Experience of Inquiry,” brings inquiry into teachers’ hands and teachers themselves literally onto their knees as they measure the diameter of a crater formed by a marble dropped onto hot chocolate. Based on the cratering activities, inquiry discussion threads grow long as diverse expressions of inquiry instruction are interwoven throughout. In this topic, participants also view the videotape “Geometric Supposer” from Sunburst Communications, Inc. Sunburst gave us permission to make copies of the video, which American Video in Concord did for us at a whopping discount.

Participants then use a “Tool to Support Inquiry,” one of 11 inquiry-based math and science tools. Some of the tools, such as GenScope, Hands On Physics, and Global Lab are themselves a product of other NSF-funded projects. Mars Exploration comes from NASA’s Jet Propulsion Lab. Environmental Decision Making was offered free of charge to INTEC participants from the BioQUEST Curriculum Consortium. Many of the commercially available products are also sold at sizable discount to us. Using these tools, teachers are guided through inquiry activities.

In the “Content Support for Inquiry” unit, teachers design inquiry activities of their own and prepare to use the new tool with their students during the practicum.

So, if you’ve lost your marbles and you’re a middle or high school math or science teacher registered for INTEC this fall, expect them in the mail, along with hot chocolate, cardboard, clay, books, videotapes, and more. Otherwise, you might check with the West Concord Five and Ten—they’re quite good at locating marbles. @

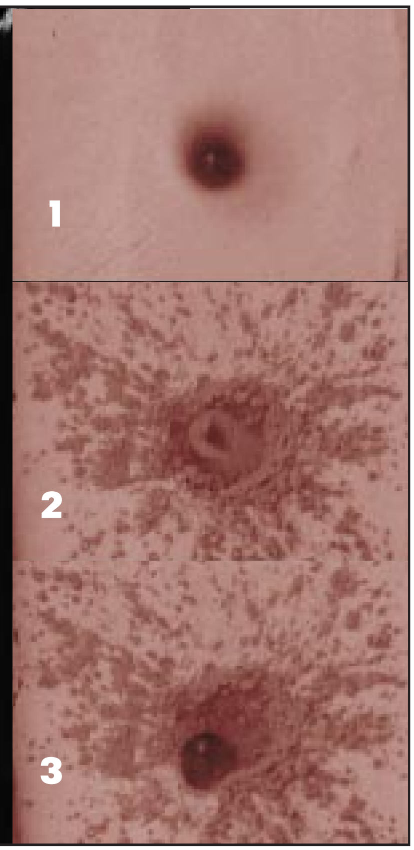
Cynthia McIntyre is the Project Coordinator for INTEC. Organizations large and small have made significant in-kind contributions to the project. If you are interested in making a contribution to INTEC or another project of The Concord Consortium, please contact us at info@concord.org.

Create a Crater

MATERIALS—
- marbles
- white flour
- pizza box
- hot chocolate
- meter sticks
- dropcloth
- shaker
- ruler

Simulate crater formation by making a “planetary surface” and impacting it with falling bodies. In a shallow box (a pizza box works great) on a drop cloth, spread white flour one-half to one inch thick (just below the top of the box). Pack the flour lightly and use a ruler to smooth the surface. Shake a thin layer of cocoa on top. From a height of two meters, drop one marble. Measure the diameter of the crater formed. Repeat the procedure with larger or smaller marbles . Then try dropping them from different heights. Record your results.

The progressive pictures on the right show how the marble impacts the flour and hot chocolate to create a crater.



LINKS ON THIS PAGE

Mars Exploration—teaparty.terc.edu/projects/mars/marsed.html
Annenberg/CPB—www.learner.org/aboutacpb
Global Lab—globallab.terc.edu
Jet Propulsion Lab—www.jpl.nasa.gov
GenScope—genscope.concord.org
Hands On Physics—hop.concord.org
Sunburst—www.sunburst.com
BioQUEST—www.bioquest.org

“This kind of science is very valuable. You get to do field work outside the classroom. Get to know your teacher. Your teachers get to know you. It’s actually fun.”

Emerging Technologies

continued from page 2

Also detailed are the research findings on how this technology has affected student learning and how the technology has evolved since the project’s inception. It looks at current developments under way, as well as future expectations.

Although the book is geared toward K-12 educators and researchers in science, it focuses on middle and high school grades. It presents strategies to help students learn science content as well as the processes and nature of science, and examines the challenges teachers face teaching in this way.

It also explains data on student understanding, active involvement, and skills development over time. The editors discuss what has been learned about the incorporation of this technology in various learning environments through practical experience.

“Tools such as probeware and software expand the range and sophistication of possible student projects,” explains co-editor Joseph Krajcik. “The project-based approach to learning can be powerful and highly motivating.” @

Date of publication: Spring 1999

Kathryn Costello is the Project Coordinator for Science Learning in Context.

Precision Online Moderating

New book on supporting learning in virtual communities

How many different voices do you use in your online communication? If you are moderating a discussion, do you vary your voice?

The learning that takes place in online discussion groups depends critically on the skills of the group leader, or moderator, who must make effective but restrained interventions to steer the group learning process. A forthcoming manual sponsored by The Concord Consortium is designed to expand the effectiveness of moderators by providing new ways to think about how and when to intervene.

“Precision Online Moderating: Supporting Learning in Virtual Communities,” to be published by Plenum Press, draws on The Concord Consortium’s extensive experience developing teacher professional development netcourses.

This manual is based on the instructors’ experiences teaching one of these netcourses, which is designed to increase teacher understanding of inquiry as an educational strategy in secondary mathematics and science teaching. This online course is offered to groups of 20 teachers led by moderators who are trained to lead online discussions in an inquiry-based environment. This model of using moderators to shape participant learning has many important implications for teaching any online course.

As educators and professionals increasingly move to the Web as a vehicle for teaching and learning, it is important to realize that skill at moderating online communities is a critical element in their success. Strategies include the use of a variety of voices, styles, and types of questions which may be employed in various combinations.

If successful, the moderator can create an environment in which participants together generate an understanding that is powerful and lasting.

Written by staff members of The Concord Consortium who have extensive experience working with the Virtual High School and INTEC projects, “Precision Moderating” will prove useful to anyone willing to jump in and learn by doing. @

Date of publication: to be announced

LINKS ON THIS PAGE

Plenum Press—www.plenum.com

Virtual High School—vhs.concord.org

INTEC—intec.concord.org

Perspective

CC Services

by Robert Tinker

"The excitement generated by our research has led to a demand from educators for our innovations."

New information technologies are a driving force for change in society, giving rise to new industries, greater efficiencies and increased personal freedom.

In the four years since The Concord Consortium was founded, we have focused on implementing educational innovations that use information technologies. Major federal grants have allowed us to make important advances in developing NetCourses—online courses—for training, moderation and course delivery; in using hand-held, portable computers in the classroom; in developing new computer environments for science education; and in the design of technology-rich education for sustainable development, math, and physics.

By merging appropriate new technologies with the best educational research, we have been able to create vigorous, innovative and inclusive learning experiences.

The excitement generated by our research has led to a demand from educators for our innovations. In response, we have created CC Services, a service division of The Concord Consortium, specifically designed to disseminate our developments worldwide. Our grant supported work has given us considerable expertise in online courses, technology-rich materials development, software design, and portable computers. Through CC Services we are able to share this expertise with schools and businesses through workshops, online courses, consultation, and public speakers.

The Virtual Classroom

Two introductory workshops which CC Services is offering in November (see page 11) highlight one of our most exciting and successful research areas—online learning and the virtual classroom. Many schools and businesses that are developing virtual learning environments are looking for sound advice on how to implement a virtual classroom. As the developer of the successful Virtual High School project, funded by the U.S. Department of Education, we have become an acknowledged leader in development and pedagogy of online learning. Our fall workshops, held at Shelburne Farms, near Burlington, Vermont, at the site of our Center for a Sustainable Future, are for teachers, administrators, and others interested in understanding more about online learning.

At a later date, we will also be offering comprehensive NetCourses that can help you create virtual institutions:

- A package of courses for administrators, staff and teachers who want to create their own virtual institution.
- A series of three courses for becoming a part of a Virtual High School.
- An advanced course on multimedia for NetCourse faculty and teachers.

Science Education

CC Services will be offering workshops in science education, including how to implement a hands-on physics curriculum for high school and how to use a manipulable software package for teaching genetics. We also have developed courses that explain how to bring inquiry into the science and math classroom, and how to use scientific probes to support learning.

All of our NetCourses and Workshops are based on our research in educational technology.

Consultation

The staff of CC Services is available for consultations on specific projects, including the virtual classroom, mobile computing, international networking, online collaboration, and new approaches to modeling in education.

We hope you will join us in November to explore these and many more new and exciting frontiers. @

Robert Tinker is President of The Concord Consortium. Contact CC Services at ccservices@concord.org.

LINKS ON THIS PAGE

CC Services—ccservices.concord.org
U.S. Department of Education—www.ed.gov
Virtual High School—vhs.concord.org
Center for a Sustainable Future—csf.concord.org

info@concord.org

Join Us Online

Redecorated Web Site

In September we finished a redesign of our overall Concord Consortium web site, which has evolved to meet the needs of progressive, new technologies. Thanks to our web diva, Jeannie Finks, we have a fresher look and up-to-date information about the organization.

We now have extensive information about our four Centers and the projects associated with them:

The Educational Technology Lab
The Center for a Sustainable Future
The Modeling Center
The International Center

Our site contains articles about educational technology by our staff and others, back issues of @CONCORD, and various educational resources, including a video production guide and a list of useful web addresses. There is also information about The Concord Consortium, including our strategy and vision for the future of education, and how to contact us. We have also visually incorporated elements of nature that clarify the meaning and mathematics of our sunflower logo (see the following heading).

www.concord.org

Mathematics of a Sunflower

Ever wonder why we have a sunflower for our logo? We chose the sunflower because it is a beautiful representative of the close association between mathematics and nature, one that the Greeks used also for the construction of the Parthenon.

The inner spirals of the sunflower are actually a mathematical series, called Fibonacci numbers, that nature evolved as a way to prevent wasteful overlap of leaves on a stem. The series is formed by summing two consecutive numbers to get the next number. The first ten Fibonacci numbers are 1, 1, 2, 3, 5, 8, 13, 21, 34, 55. If you count the number of spiral arms in each direction of a sunflower, you find Fibonacci numbers. You'll also find Fibonacci numbers in pine cones, sea shells, and other natural forms, many of which are now on our web site.

www.concord.org/pubs/pdf/mathdes.pdf

The Concord Consortium
37 Thoreau Street
Concord, MA 01742

PHONE 978.369.4367
FAX 978.371.0696

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