Learning With the World Wide Web: Connectivity alone will not save education

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The World Wide Web holds promise as a tool for meaningful learning but only if it is used in conjunction with teaching methodologies appropriate to this new medium. This paper discusses how the Internet and World Wide Web might be used effectively in learning environments.

Disasters & Epidemics: Demands for Nonlinear Thinking

I am certain that each of you remember Jessica McClure, the 18 month old baby in Midland, Texas who fell into a narrow, uncapped well. The media surged in and invited the world to listen and watch as Jessica's rescue was engineered. Fifty eight hours following her fall, Jessica was lifted from the well safely into her parents' arms. While millions of people looked on and held their breath awaiting baby Jessica's rescue, thousands of other young children around the world lay dying of hunger and preventable disease.

Today's heroes are created by television and radio media. Abstract ideas are made concrete through the words of newscasters and newspapers. Television has destroyed the need for a vivid imagination by offering the viewer all the details and leaving no room for questioning. Furthermore, the details are often incorrect.

Part One of the March 19 Sunday Los Angeles Times reported a situation which illustrates this point beautifully. The headline read, "Determining Time of Death is Imprecise Science at Best: Simpson Case: 'Quincy Syndrome' has set unrealistic expectations." A significant problem has been created for the prosecutors of the case who must confront this "syndrome". Named after the popular television show about a medical examiner, it is the unrealistic notion that a coroner can establish to the minute when a crime victim died. In the non-television world, nothing could be farther from the truth according to the forensic experts and lawyers involved with this case who must confront this false "knowledge" held by the jurors and general public.

Journalism, television, and film are promoting thinking which tells us that "anything is possible". Time has become completely abstract and numbers even more so. To relate to disasters and events concerning large numbers of people society today must be shown a concrete realization of the abstract phenomenon. Our schools, parents and community learning centers need to think about today's media and how they are affecting our children and their thinking.

Let me take an example from my work with several schools in the Los Angeles area. Recently, a fourth and fifth grade class constructed periscopes as part of their science curriculum. After making the periscopes from PVC tubing and two mirrors placed at 45 degree angles, the students were asked to go to the playground and use the periscopes to explore the world around them. They were then asked to write their observations, thoughts and questions.

After the observation and experimentation, the children wrote comments like, "the library was upside down, the street was right side up, the bus was upside down, the ground was on the sky". Not *one* child questioned this phenomenon, but readily accepted this crazy change to their world and wrote it down. Additionally, none of the children were intrigued with how the periscope accomplished its illusions. How can we blame them? In the worlds delivered to them by Hollywood and 3D game designers these changes are trivial.

In conjunction with the periscope experiment, the students were asked to think about listing the traits of a good scientist. The children's list included that a scientist must have the ability to read and write, be a good listener, pay attention to what they are looking at, have lots of ideas, study unknown things, and have patience. A visiting physics professor from UC Berkeley reviewed the list and stressed to the children that the key which they had forgotten was that a good scientist needs to be skeptical, ask questions, and *not* accept everything. A good scientist needs to continually ask ***why***.

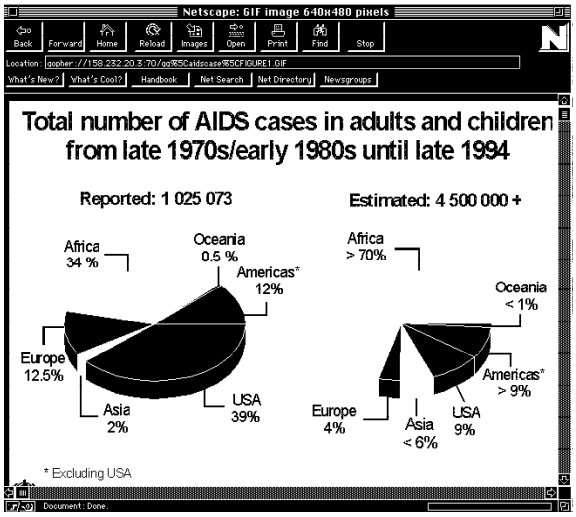
It is tragic that today's children readily accept the world around them with a credulity that is similar to that in the middle ages. A mission of our educational system must be to revitalize our children's imaginations. We need to create heroes from abstract ideas and thinking, not just theconcrete scenarios conjured and delivered to us by the media. It is critical that we teach our children how to think abstractly and in a nonlinear fashion.

This lack of imagination and disability to think nonlinearly prevents our children from understanding many critical phenomena. One example is the HIV virus and AIDS epidemic.

People may relate when they see Magic Johnson or Greg Louganis on television speaking of the virus which has invaded their system or they read of Arthur Ashe's death on the front pages of newspapers, magazine and books. But when confronted with numbers and the exponential growth of this virus, children (and adults) loose the ability to understand.

As of December 31, 1994, 1,025,073 cumulative AIDS cases in adults and children have been reported to the World Health Organization Global Progamme on AIDS since the onset of the pandemic. This represents a 20% increase in cases since the January 4, 1994 report.

What does this statement mean? It is my belief that the majority of people faced with these numbers embedded in text do not really understand this statement *at all*. Here is a chart representing the same information and additionally providing a breakdown by geographic area:



Representing this information visually can certainly increase our understanding of the growth and spread of the disease. Using computers to illustrate and simulate the situation dynamically, is even more powerful.

If we can get our children to really *understand* what is transpiring throughout the world with the HIV virus, for example, we will create "heroes": They will come forward in the form of scientists, doctors, and humanitarians.

The Internet can be a tool which our students can use to promote nonlinear and abstract thinking, to encourage them to question their world, and to revitalize their imaginations.

Rushing onto the SuperHighway

The "Internet", the "Web", "gopher", "telnet" "ftp", "networking" -- these are all the latest buzzwords being tossed around today in schools throughout the world. We must be careful not to look to this technology with hopes that it will be the next band aid for education. Installing computers, software, networking hardware, telephone lines and cabling in our schools will not change the way our children think unless we use these tools in new ways which take advantage of the possibilities the new tools have to offer. It is more likely that these new technologies will be used in ways which just mimic the old media and therefore not gain us any new insights into creating better learning environments.

Technology is employed in classrooms today in two ways: "Telling technology" and "doing technology". A group of students passively viewing a cable downlink lecture on the destruction of the rainforest is an example of "telling technology". "Doing technology" employs the same group of students, studying the same phenomena, but by *actively* acquiring data, comparing opinions, and exchanging information with fellow learners and experts around the globe -- in addition to watching the video downlink.

My research colleagues and I hold the belief that when the technology is employed as "doing technology" is when students can become fully empowered. It is using the technology in this manner that we can enable students to turn information into knowledge and promote learning with deep meaning and true understanding of often complex material.

What is Distance Learning?

To many people distance learning means arranging for a specialist to deliver a lecture to a group of students in a remote area which could not otherwise have had that lecturer present. But in doing this, we are turning our computer monitors into television sets or perhaps not even using our computer monitors at all, but using telephone lines or satellite technology to deliver television to our classrooms. We need to think beyond the medium we have been passively watching for the

past forty years. We need to create new vocabulary and new definitions and exploit our new media to its fullest capability.

When color television was first introduced one big breakthrough was the idea of placing of a red, green, and blue colored plastic overlay over the television screen, thus turning the black and white image to "color". Another early application of color was to adorn the stage with colorful blocks or other materials to stand behind the entertainer. (This actually distracted the viewer's attention from the "content".)

We look back at these early images now and laugh at how ridiculous the ideas were. I am certain that our current uses of telecommunication technologies will look just as ridiculous to us in the years to come, as the pioneering applications of color television did to us in the past.

What is Computer Literacy?

Computer literacy is not learning where the on and off switch to your CPU are located, nor is it knowing what the letters "CPU" stand for, and computer literacy is more than just word processing. Like literacy in other domains, to be computer literate one must be able to recreate ideas from representations , (reading) and from that material be able to construct representations of complex ideas (writing). Students need to become facile manipulators of information to the extent that they can find it, think about what they have found, sort through various points of view and then form their own opinions and arguments. They need to go beyond reading essays to creating their own. Access and generation of ideas and arguments need to span all disciplines - language, mathematics, the arts and sciences. We are just beginning to explore the potential which the computer and telecommunications tools hold to assist our children in becoming fully literate adults.

"Information required for productive citizenship is changing rapidly. It is now essential to present instructional content that is live, that comes from active information sources such as weather satellites, data collected by students in other locations, and responses from working scientists. School work must include primary information sources so students are simultaneously learning the critical content while gaining firsthand experience with information sources themselves"[1]

The Internet can be a wonderful tool for learners to become more literate. We must be careful here however, to not confuse fact finding or gathering "information" with attaining "knowledge". Sending children on Internet "scavenger hunts" may prove useful to hone their skills at using various tools which make the Internet easier to navigate, but it doesn't create "knowledge". Knowledge results when an individual personally transforms information.

The information access skills required in order to "navigate the Internet" however do require an important type of thinking on the user's behalf and this should not be overlooked. When challenged to find information on a particular topic, the student can choose several directions and has many tools available to assist that choice. Students will often have to shift their thinking and information gathering strategy in order to find the appropriate material .

One group of students I am working with is using the Internet as another resource to find material on whales. Each student is studying a different type of whale such as the fin whale, narwhal, or killer whale. I observed one child as she searched for information on her whale's breeding habits. Upon her first query she entered the words "killer whale". This approach did not return her a lot of useful information. Upon further thought, she said, "The scientific name for the killer whale is 'Orca', let's search under that". She then received some valuable information.

What is meaningful learning?

Children need to learn to approach problems and access information in various ways so they can later think about the information they find, digest it and formulate their own opinions. They need to develop their intuitions about the world. Learners need to be encouraged to use *all* of the resources available to them. When challenged with a project we need to encourage our children to access information from books, magazines, CD ROM, the telephone, and other people. Children should think first about what *combination* of resources they might use to assist in their learning. Using the resources in this way will provide for a meaningful learning environment, one where the student is at the center of their learning and will be learning for deep understanding and not merely for rote feedback to the teacher.

As I mentioned previously, teaching methodologies must change with the introduction of new media. Teachers must assume the role as co-learner and facilitator in a *collaborative* learning environment alongside their students. Usage of new media in the classroom being such a current phenomenon, with the technology advancing so rapidly, it has become even more difficult for teachers to keep ahead of their students. Children are using new media in their homes. Many parents

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[1] Denis Newman, Susan L. Bernstein, and Paul A. Reese, "Local Infrastructure for School Networking: Current Models and Prospects, " Bolt, Beranek and Newman, Inc., Cambridge, Mass., April 1992, p.3.

are using email and other Internet tools in the course of their work. Look at the magazines next time you visit a newsstand. Eight out of ten have some mention of the "information superhighway", "cyberspace" or "online services". The April issue of *Vogue* featured an article titled, "What's Cooking in Cyberspace"; *Time* published a special issue called "Welcome to Cyberspace" and *Architectural Digest* features a monthly column called " AD Electronica". The "information explosion" demands change, but this is a difficult change for many teachers.

To no longer be positioned as the "know it all" authority , but to step down from that role and say to the student "let's find out together" takes a lot of courage. We will only create more powerful learning environments for our children if teachers are willing to have this courage. Many of these courageous teachers are coming forward and engaging themselves and their students in wonderful interactive learning environments. The World Wide Web offers us such an environment.

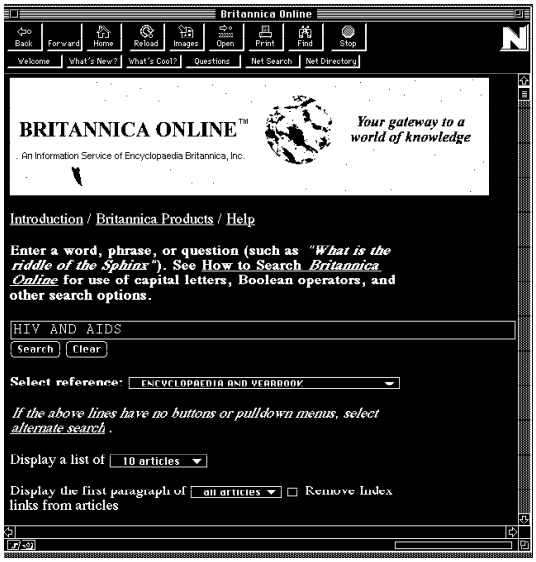
The World Wide Web

I'd like to explore the idea of our utilizing the World Wide Web as *another* valuable tool; another "place to go" for learning, in addition to people, places, books, and the telephone. Because of its dynamic multimedia makeup, The Web can be a fantastic tool for constructivist learning. It can be used as a means to gain understanding into complex systems and ideas.

In his book "On the Road", Charles Kuralt said, "Thanks to the interstate highway system, it is now possible to travel across the country from coast to coast without seeing anything". Our challenge is to find ways of using the Internet and World Wide Web as a mechanism for learning for understanding, and as a mechanism for "seeing things", not just as a highway system for haphazard travel.

To be used in a meaningful way, we need to embed the use of this tool into a context; our teachers must guide its use and provide direction to set the stage for deep learning, and not for the gathering of disjointed information.

Upon a first look the Web can be seen as a source for reference material. It houses an abundance of basic references now including the Encyclopaedia Britannica Online. The most exciting part of "EB Online" is that the editors have begun to link encyclopaedia entries with outside Internet resources. For example, following an entry on Antarctica might be a hypertext link to a Web site about Antarctica, in Antarctica.



The Web can also serve as the virtual library of libraries -- learners can now gather reference materials from public and private libraries around the world -- general and specialized.

The Web can be a "place to go" to amplify a learning experience or broaden a student's insight into a subject area study. Fourth and fifth graders studying World War II and the Holocaust can now "visit" the Holocaust Museum in Washington DC. Science work can be explored by "visiting" Science Centers such as San Francisco's Exploratorium or Ontario, Canada's Science Center. The Web can certainly provide the basis for an environment for collaborative and comparative learning.

Perhaps one of the most exciting uses of the Internet and World Wide Web is its potential to be used to connect people. There is always a "who" behind the "what" you discover on the Web. Most times that person's email address is listed and a curious learner can get more information by directly sending email to the site's "Web Master" or persons involved in the subject area the site addresses.

The potential the Web offers to build virtual communities is tremendous. Large and complex problems which concern us are now not only up to

individuals to solve. By means of global networking on the Internet special interest groups and clubs are being formed. These groups can break down large issues into smaller ones and collaborate to solve problems. Mathematicians, for example, have joined forces to work on large problems via the Internet. Working in this manner they have been able to make new discoveries and find solutions.

The notion of learners contacting subject matter experts or "SMEs" is being explored in classrooms around the world. Once again this reinforces the belief that the classroom teacher need not be the single expert which the student has to query. Roger Schank, Director of Northwestern University's Institute of the Learning Sciences (Evanston, IL) sees computers as a gateway to electronic mentors. "They can provide built-in experts that are available on-line, looking over your shoulder", he says. "So, instead of today's model, where you have one expert at the front of the room talking to a lot of people, it's reversed: You have one user at a computer with hundreds of experts built in". [2]

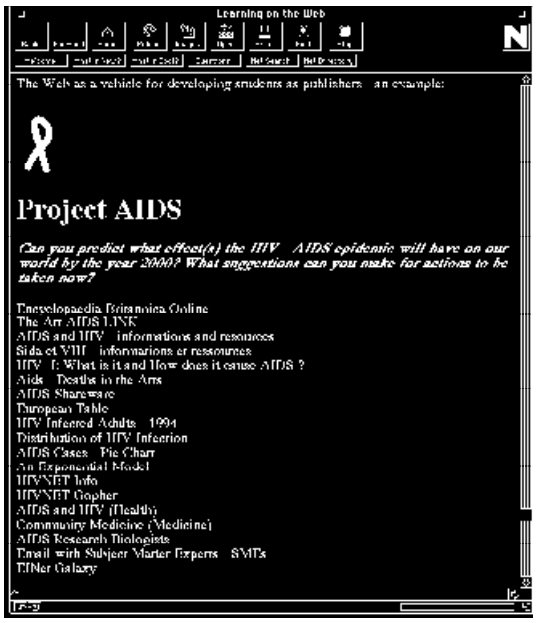
Learners can easily find subject matter experts via the Internet and use email to exchange ideas and opinions. We have found that most of these "experts" have been exceptionally willing and enthusiastic to work with learners when approached via email and a structure for exchanging communications is set in place.

When a student takes all of these resources and combines them, the Web can become a mechanism for developing learners as serious writers and publishers.

Constructing the Superessay

I'd like to describe a project for fifth and sixth grade students where the use of each of the areas of research previously discussed are utilized and embedded into a content area for student exploration. The content is timely, of critical importance to each of us today, and requires thinking about complex issues in a nonlinear fashion. In this case, the students are asked to write an essay on the following question: Can you predict what effect(s) the HIV/AIDS epidemic will have on our world by the year 2000? What suggestions can you make for actions to be taken now?

To gain intelligent understanding of the current pandemic situation students will need to gather information on HIV and the AIDS virus at various levels. After using the Web for searching for current information and figures, the students can exchange their ideas with fellow students and experts. Following is an example of Web sites relating to the subject where students can find varying information, in text, graphic and numeric representation from sources around the world.



In addition to written articles and graphs, we also found a piece of shareware written to help students think about the growth of AIDS, and a gopher site where students could query the computer in real time with any question they might have about AIDS, and "the computer" would answer.

A group of HIV/AIDS research biologists were located at another site. Email was sent to the group, describing the project, and asking them to help explain the nature of an epidemic and the concept of exponential growth to children of this age group. Here is an excerpt from some email which was exchanged with one researcher in Trieste, Italy:

To the expert: "...How would you [briefly] explain the nature of an epidemic so that a student 12 or 13 years old could better understand what is happening currently in the world with the AIDS virus? The exponential growth which is occurring (as well as a call for non linear thinking) is generally beyond a student's ken. They cannot relate to the "numbers". What would you tell a child investigating this type of model?"

A reply: "Considering the age of your audience this is a very difficult question. I've been thinking quite a lot about it and have come up with a major concept which can be presented as it stands but which also can be modified to make it more a true reality. Here is goes: CENTRAL CONCEPT:

[2] Byte Magazine, "7 New Ways To Learn", March 1995, pg. 52.

HIV-1 epidemics can be described as a "wildfire" during a strong, windy day. For reasons unknown you have an initial event, maybe a spark setting fire to a bunch of leaves. The fire catches and begins to spread among the leaves. Now comes into play the action of the wind, carrying here and there burning leaves and beginning new fires in distant locations. Eventually, the whole forest may catch fire unless something is done to prevent it.

MODIFICATIONS: I think that the above concept can well be applied to any epidemics without having to deal with large numbers. If you think the concept is not too difficult you can also adapt it to take into account the existence of different viral "strains". You can do this by introducing the concept of an initially many-coloured fire sending off singly-coloured sparks. Where they land you observe the start of singly-coloured fires. You could also introduce the concept of present-day doctors and scientists as good-willed "firemen", trying to stop the fire from spreading. Additionally, the spreading of AIDS as a forest fire can also be used to stress not only the need of good "firemen" but also the concept of "prevention" which, unfortunately, is probably the best defense against HIV-1 at the moment. Therefore, just like it is irresponsible to drop burning matches in a forest, there is a high-risk and low-risk behaviour as far as being infected by HIV-1 (for example, here in Italy HIV-1 is mostly transmitted through drug use). This is what comes to my mind at the moment. If you have any additional questions do not hesitate to contact me, I quite enjoyed thinking about this question."

After the student has successfully gathered their information and integrated it into their thinking, they can use the Web again , to publish their own findings and arguments in the form of the "superessay". This multimedia arena for expository writing can allow students to integrate text, graphics, audio and video into a single dynamic document.

A most powerful addition to the superessay is the inclusion of student-designed simulations which can be used to better understand and explain the nature of complex systems to others. For the AIDS project, simulations were created using StarLogo and CodeWorks to help students understand the nature of epidemic and exponential growth. The simulations can become a dynamic part of the html superessay to illustrate the growth and spread of the virus. "Readers" of the essay can run and watch the simulations as well as manipulate the model themselves to see how conditions might change if the data put into the model were to change.

The use of the World Wide Web and students publishing their own documents using html and other authoring tools which are being developed will take over where HyperCard began. Teachers have seen a tremendous impact when their students create reports using HyperCard. Now students can create dynamic documents using html and publish them on the World Wide Web to share with learners around the world. The potential of integrating the media and using it to enhance understanding and to create meaningful learning environments remains yet to be fully discovered.

Postscript:

For the year 2000, the current WHO projection is that there will be a cumulative total of 30-40 million HIV infections in men, women and children, of which more than 90% will be in developing countries.

About the author:

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Kim works with a consortium of schools in Southern California to develop collaborative dynamic curricula accessed through a newly created wide area telecommunications network.

Kim received her Bachelor of Arts Degree in Fine Arts from the University of California, Los Angeles (UCLA) in 1979 and has worked at Apple Computer since 1986. Kim is a volunteer for the Los Angeles Chapter Center for Adult Literacy, and a member of the Board of her local public library.

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