CYBEREDUCATION:

EFFECTIVE INTERNET TEACHING TECHNIQUES FOR THE INFORMATION AGE

by

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INTRODUCTION

Cybereducation is not a word I have run across in my readings. It is a word I have constructed myself after exploring the Internet and reading widely in the Futuristic literature. In this paper I invite you to accompany me on a cyberjourney.

Before I begin the tour I ask your patience as I briefly review some popular works in Futurism. I believe this background is necessary to understand the enormity of the Information Revolution we are presently experiencing.

OUR CHANGING WORLD

Our planet is presently experiencing a mind crunching revolution. It affects the way we bank, the way we communicate, and the way we educate our young. It is so comprehensive that it is sometimes difficult to see and explain.

What is this revolution? It is called many things by many people -- but most often it is referred to as the Information Age. The engine of the Information Age is the computer -- complete with supporting telecommunication equipment.

Alvin Toffler wrote a series of books that describe this revolution. In 1970 he released Future Shock. In 1980 he followed up with The Third Wave. In 1990 he explained the changes in further depth in Powershift. These writings help us surf the Third Wave rather than get caught in its undertow.

John Naisbitt and Patricia Aburdeen wrote Megatrends (1980) and Megatrends 2000 (1990). Recently (1994) Naisbitt released Global Paradox. In this work he tells why the nation's telecommunications infrastructure will determine its place in history in the Twenty-First Century.

These authors agree that the well-educated citizen is increasingly important to American leadership and economic stability. Is it any wonder then that education is currently on the national agenda? Yet, even when education is doing very well by past standards it receives criticism. Why? In great part this criticism is leveled because new skills are needed for the new age. At present these new skills are poorly defined and the teaching/learning methods to accomplish the learning tasks are even less well defined. However, innovative educational projects abound due to creative individuals feeling their way into developing a new learning system. This paper will explore a portion of the search presently going on for a new teaching/learning methodology.

A UNITED STATE'S ANSWER: THE NII

Our national leaders looking outward ten and twenty years into the future have proposed the National Informational Infrastructure (NII) as a means of maintaining American leadership into the Twenty-First Century. Two Internet documents are useful in understanding the NII concept: The National Information Infrastructure: Agenda for Action (1994) and Benefits and Applications of the National Information Infrastructure (1994).

A third Internet document entitled Getting the NII to School: A Roadmap to Universal Participation (Beranek & Newman, 1993) discusses present plans for linking schools to NII. The present plan calls for all the nation's schools to have at least one device connected to the NII network by the end of 1996.

When the NII is complete businesses, government, average citizens, and non-profit institutions (of which our educational system is a part) will be linked through satellite, microwave, fiber optic cable and anything else that is useful in the transmission of information. The complete NII is not yet with us. However, the NII will subsume the Internet as presently fashioned (Roberts, 1994). By looking at current innovative educational projects taking place on the Internet we may be able to 'piece together' some understanding of Cybereducation as it will emerge in the Twenty-First Century.

METHODOLOGY

This paper overviews projects that are presently available on the Internet through Mosaic search capabilities. Consequently, if the reader has Mosaic available to them they are encouraged to READ the paper and simultaneously SEARCH Mosaic. All project Mosaic URL's (as of December, 1994) are listed in the reference section under the subtopic "Mosaic Linkages to Projects". (A URL is the mailbox address for Mosaic documents.) By both reading this paper and searching the Internet the reader can EXPERIENCE the new teaching methods. (This paper is also available as a Mosaic document. When using the Mosaic version the reader can just point and click to the project references and be immediately 'transported' to the projects.)

Our goal is to widely sample learning/teaching projects and examine the educational practices that 'make them work'. We cannot go everywhere or see everything on our journey. Consequently, we will narrow our focus in three ways. First, it will use Mosaic as our sole search tool. Secondly, we will narrow our focus to documents that describe current educational projects. Thirdly, we will focus only on projects conducted through institutions whose major function is education.

In total, our focus is to explore the learning/teaching practices that are emerging when learning is being conducted in the cybersphere. We will be guided by the theoretical work of Carol Twigg, Beverly Hunter, Robert Tinker, Roger Schank, and Chip Cleary.

THEORETICAL UNDERPINNINGS

Dr. Twigg is the Vice President of Educom a group of Higher Education institutions dedicated to exploring ways to make current technology more efficient and effective in education. Dr. Twigg (1994, 1994) calls for teaching students to learn how to learn which includes: critical thinking, quantitative reasoning, effective communication, search techniques, and working with others. She calls for individual learning in customized learner-centered environments. She asks for a mentoring format in which the mentor works with the individual student to help achieve that student's goal.

Dr. Beverly Hunter (1994), expresses her thoughts in 'Learning and Teaching on the Internet' on a learning/teaching technique she calls 'authentic education'. This type of education opens up the entire world as the base of knowledge to solve real-world problems by interdisciplinary projects. Students often work on the projects collaboratively with other students and with teachers. Students study in a Just-In-Time learning mode rather than follow a preset curriculum sequence and actively construct their own knowledge base rather than staying in lock step with their age mates. Dr. Hunter wants students to upload their work as well as download the work of others.

Dr. Robert F. Tinker (1993, 1993) is the Chief Science Officer of TERC. He is against the Industrial Revolutionary form of 'storehouse' education which he describes at atomisticly breaking down topics into studies then into lessons, etcetera. Instead he proposes a method of teacher support of learning that is interdisciplinary and integrative. He wants students to work on current problems using a hands-on and project based format. He wants students to select their project and have the freedom to work within their own learning style. This method does not require telecommunication. However, when telecommunication is added excitement is increased through worldwide collaboration with people unlike self, increased access to databases, and student dissemination to the world at large. He also encourages a pairing of university centers and schools.

Roger Schank and Chip Cleary (1994) are authors of the hyperbook, Engines for Education. Both gentlemen develop experimental learning projects for the Institute for Learning Sciences (ILS) at Northwestern University. They call for a teaching style that helps the student discover answers. They want teachers to help children muse and question while exploring a wide range of opinions. They call for teaching situations in which factual knowledge can be naturally acquired.

EXPLORING INTERNET PROJECTS

Fourteen projects are briefly described below. This paper focuses on the learning/teaching methods used in the projects rather than on the projects themselves. As explained above, it is the writer's desire for the reader to become actively engaged in exploring the database. She hopes this paper will facilitate an exploration of the database so readers can actively construct their own knowledge base defined by their own particular interest in the subject using their own particular

learning style. The readers are encouraged to pose their own questions and discover their own answers and to consider the writer's opinion as but one of many possible opinions. The writer will feel successful if she has helped her readers muse and question.

(1) Arizona Mars K-12 Education Program Information.

This project began in 1992 as a means of disseminating the Mars Observer mission into the schools. When communication was lost with the Mars probe the project mission was expanded to teaching about the solar system in general. ASU/Mars is headquartered at Arizona State University. Funding is supplied by NASA. The project includes active dissemination of text, data, and graphics on the home page along with development and dissemination of support tools for the classroom. ASU/Mars holds semiannual training workshops for teachers.

The ASU/MARS cyberdocumentation is impressive. Special attention is called to solar pictures located at http://esterila.asu.edu/asu_tes/TES_Editor/dsn_solarsyst.html.

(2) Ask-A-Geologist

Beginning October 4, 1994, the U.S. Geological Survey Branch of Pacific Marine Geology is offering a free service to the schools. Children can e-mail their geological questions to ask-a-geologist@octopus.wr.usgs.gov and receive an answer in a day or two. After several months of fielding questions, USGS plans to post a FAQ document.

(3) Ask Dr. Math

"The Swat Team" of Swarthmore College will field math questions of K-12 students. The project is funded by the National Science Foundation. Questions can be e-mailed to dr.math@formum.swarthmore.edu.

(4) AT&T Learning Network

AT&T is involved in helping K through 12 teachers create virtual "Learning Circles" composed of geographically and culturally diverse classrooms. These Learning Circles are made up of seven to nine groups of students in different locations around the globe. Together they explore the same curriculum and communicate toll free via unlimited use of AT&T's Easy Link Service global network. Upon acceptance into a circle, classes introduce themselves to other components of the circle. The classes then design a project drawn from classroom curriculum developed by AT&T. The curricula materials are written to grade level. Much of the transmission time involves exchanging the work of students. The goal is for circles to put together a Circle publication of their collective work. Project can be in writing, mathematics, science, history and geography, social studies, and current global issues. A typical 6 week session costs the school $195.

(5) Big Sky Telegraph (BST)

BST is an on-line educational community network based in Wyoming. It is dedicated to supporting teleliteracy in rural America. BST provides free access to its bulletin board and free on-line lessons to the Internet. However, actual use of e-mail and full access to the Internet comes with a low fee.

One of BST projects is called Off-line Reader. In this project individual students subscribe to their own newsgroups. Through BST mediation software each student inserts their own disk into the school telecomputer and receives their own messages. Students then read the messages at their microcomputer workstation and compose return messages. Later in the day all students reinsert their disk. Messages are automatically uploaded to the discussion groups after midnight to obtain optimal phone rates. This method facilitates cybereducation where telecommunication equipment and budget are limited.

(6) The CoVis Project (Learning through Collaborative Visualization)

This project is devoted to teaching earth and environmental science to high school students using authentic scientific visualization tools. It specializes in electronic collaboration between high school students, university professors, and graduate students. Funding is supplied by the National Science Foundation and a host of businesses including Sony, Apple, and Sun Microsystems. Partners include The Exploratorium, Department of Atmospheric Sciences (University of Illinois), and Department of Electric Engineering (University of Michigan).

The project contains several unique components that support collaboration. One is the Cruiser videoconferencing that allows video conferencing between two individuals. A second is Timbuktu screen sharing which allows one individual to control the computer of another. A third is the Collaboratory Notebook, a groupware package designed for note taking and sharing. This package is designed to follow threads resulting from observations.

Collaboration connects high school students, university professors, and graduate students. During the 1993-1994 school year 118 students at six high schools piloted the program. High school students work on real and current problems with their mentors. CoVis is dedicated to teaching the collaborative scientific process just as much as it is dedicated to teaching science subjects.

(7) The Empire Internet Schoolhouse

The Empire Internet Schoolhouse is dedicated to serving K-12 students and educators by allowing them to explore the Internet. It uses a gopher menu to locate resources, connect to discussion groups, access New York State College admissions, and access e-mail. It encourages electronic fieldtrips to other schools. This project receives support from IBM, the New York State Science and Technology Foundation, and the National Science Foundation.

(8) Free Educational Electronic Mail Network (FrEdMail)

FrEdMail is the oldest educational network in America to provide schoolchildren a gateway to the Internet. It is free although users must pay the costs of linking to its nearest node. FrEdMail also sponsors projects that use the Internet. One project is devoted to improving writing via projects that give students something exciting to write about. For instance in the Acid Rain project students around the country collected rain samples. They shared the data and wrote research reports. In

Experts Speak some students dressed up as historical personalities and other students interviewed them to identify who they were. The funding source for FrEdMail is unknown.

(9) Foster Project

The Foster Project is directed to teaching science to elementary and middle school students. It is sponsored by the National Science Foundation and NASA through funds distributed to SETI (Search for ExtraTerrestrial Intelligence). Material located on the Foster Home Page describes the project as using a 'hands-on' approach to encourage students to learn in alternate ways through activities that encourage questions and provide opportunities to reinforce critical thinking.

Its current project is called Life in the Universe. The project has developed teachers' guides and student workbooks as well as slides and transparencies, videos, and posters. Modules include: The Science Detectives, Evolution of a Planetary System, How Might Life Evolve on Other Worlds?, The Rise of Intelligence and Culture, Life: Here? There? Elsewhere?, and Project Haystack.

(10) Internet HUNT

The Internet Hunt was created and still operates under the direction of Rick Gates at the University of Arizona. It challenges individual children or teams to scour the public domain sections of the Internet looking for answers to a wide variety of questions. Prizes are awarded. Twelve questions are asked; the first 11 count toward the scoring. Each question answered correctly receives from 1-10 points depending on its level of difficulty. Partial credit is awarded. These 11 questions have been verified by Rick Gates. The twelfth question is the mystery question and even Rick Gates does not know whether the Internet contains the answer. Separate winners are declared for individual players and for teams. Participants have one week to respond.

(11) Jason Project (JFE)

The Jason project is the brainchild of a famous scientist, Dr. Robert Ballard (who is the discover of the sunken R. M. S. Titanic). JFE's five year strategic plan calls for it to become the worldwide standard of excellence in interactive telepresence education. It wishes to be a powerful force in both the fields of education and 'edutainment'. The Jason Project is very expensive. The past and current sponsors list reads like a page out of Who's Who in American business. It also receives cooperation from public agencies such as the National Park Service and NASA.

The Jason Project takes students on interdisciplinary scientific expeditions around the world using interactive telepresence. Telepresence is using the latest in high technology to facilitate meaningful dialogue between scientists at the site and students in the classroom. Many techniques are used to accomplish telepresence. For instance, a current project will take students to and into volcano Pu'u'O'o via remote-controlled cameras.

Expeditions include: Island Earth, Planet Earth, The Sea of Cortez, The Galapagos Islands, Lake Ontario and the ships from the War of 1812, The

Mediterranean Sea, and Belize.

JFE produces curriculum material for classroom use including interactive CD-ROMs and video games. It also holds teacher training programs. It offers fellowships to a few students and teachers so they can accompany the scientific team on the various expeditions. Recently it has begun association with the Mind Extension University to create the JASON Classroom Network.

(12) KIDSLINK

Kidslink is non-profit organization based in Norway. It is devoted to linking children and classes together to promote global dialogue. In 1994 it involved over 23,000 children in 60 countries. Kidslink is designed for children between 10 and 15 years of age.

A current project is called What's in a Name. This project will help children appreciate the history, culture, language, literature, sociology, and mythology in people's names. Another project centers around the sunken steamship SSCA. Students will explore the wreck, the passengers and crew, and the hurricane that sank her. Yet a third project is called Math Penpals. Here students communicate data on weather, price of pizza, etc. Kidslink run primarily through volunteer staffing with volunteers making out-of-pocket contributions. Kidslink also actively solicits funds from businesses.

(13) School District's Home Page

The writer conducted a Lycos search using the words 'innovation' and 'schools'. This search uncovered a host of Mosaic Home Pages owned by school districts (and in some cases individual schools). One of the most extensive home pages is owned by the San Francisco school district.

The use of school district home pages as an administrative as well as an educational tool is very exciting to this writer. All the various publics of the district can have instant access to the majority of their information needs. Moreover, a major obstacle in giving students access to the Internet is controlled. This obstacle is limiting student's search to non-pornographic material. The writer prefers to reframe the problem and work toward making avenues for exploration that complement ongoing classroom studies so interesting that students will self-limit their time in recreational areas. District home pages also allow an avenue for dissemination of student work.

(14) S.E.D.S

S.E.D.S. stands for Students for the Exploration and Development of Space. It is dedicated to strengthening the space exploration program. S.E.D.S. operates as a collection of individual chapters around the world composed primarily of high school and university students. S.E.D.S. is headquartered at MIT. Much of each chapter's effort goes into learning about space exploration through speakers, tours, films, discussion groups, and linkages to daily NASA updates. Chapters also are involved in action projects, often hosting space exploration conferences in their community. Funding is not discussed.

CONCLUSIONS

Table 1 (see appendix) displays a chart the writer used to help determine whether a new style of learning/teaching is being used in the Internet projects. The rows represent the various projects and the columns represent the criteria suggested by our four theorists. A ratings scale from 0 to 3 was used to represent how much of a criteria was present (key is included in the table). The table represents the writer's estimations. Readers are encouraged to do their own estimations.

It appears that most projects rate high on the criteria of our theorists. This may well indicate that projects that succeed are projects that allow students to do something that is real world oriented, interdisciplinary, and collaborative. The projects reviewed appear designed to facilitate student's attainment of learning to learn skills because they require and support student's active construction of their own knowledge base. Most projects allow (even require) a sharing across cultures and levels of expertise. It would appear that students are gently guided to muse and question in the process of their studies. Consequently, it appears that our theorists have given sound advice regarding what is working well in 1994 as cybereducation takes its initial steps. Undoubtedly cybereducation will evolve further as it matures.

The following four questions are posed for the reader's consideration.

(1) Is it possible that the these programs are effective only with bright students?

(2) Can basic subjects as well as supplemental material be effectively taught this way?

(3) Is this new learning/teaching method cost effective?

(4) What components need to be added or subtracted to produce a viable cybereducation model for the Twenty-First Century.

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Mosaic Linkages to Projects

Arizona Mars K-12 Education Program.
URL:http://esther.la.asu.edu/cgi-bin/imagemap/tes_home?146,330.

Ask-A-Geologist URL:
gopher://unix5.nused.gov/00/Education%20News/11-03-94%20Ask-aGeologist%20by%20E-Mail.

Ask Dr. Math URL: http://olmo.swarthmore.edu/dr-math/dr-math.html.

AT&T URL: gopher://digital.cosn.org/00/Resources%20on%20the %20Network/Educational%20Projects/AT%20T.

Big Sky Telegraph
URL:gopher://digital.ocosn.org/00/Resources$20on%20%20the%20Newwork/Educational%20Projects/Big%20Sky.

CoVis URL: http://www.covis.nwu.edu/.

The Empire Internet Schoolhouse. URL: gopher://nysernet.org.3000/1.

Free Educational Electronic Mail Network (FrEdMail)
URL:gopher://digital.cosn.org/00/Resources%20on%20the%20Network/Educational%20Projects/FrEdMail.

Internet HUNT URL:gopher://gopher.cic.net/00/hunt/about/intro.txt.

The Jason Project.
URL: http://seawifs.gsfc.nasa.gov/JASON/HTML/JASON_HOME.html.

Kidslink URL: gopher://kids.duq.edu/1.

San Francisco School District's Home Page.
URL:http://nisus.sfusd.k12.ca.us.

S.E.D.S. (Students for the Exploration and Development of Space)
URL: gopher://bozo.lpl.arizona.edu/1.

APPENDIX

Table 1
Ratings of Cybersphere Projects

Project	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1. ASU/Mars	3	?	3	3	3	3	3	3	3	3	?	3			
2 Ask-a-Geo	3	N	N	?	3	3	3	3	N	3	1	3			
3 Ask Math	3	N	N	3	3	3	3	3	3	3	0	3			
4 AT&T	3	1	3	2	?	3	3	?	2	?	2	2			
5 BST	3	2	3	2	3	2	3	3	2	2	?	3			
6 CoVis	3	3	3	3	3	3	3	3	3	3	3	3			
7 EmpireSH	3	1	1	1	2	2	3	3	3	2	?	2			
8 FrEdMail	3	3	3	3	3	3	3	3	3	N	3	3			
9 Foster	3	?	3	3	3	?	3	?	3	3	?	?			
10 I-Hunt	3	N	3	3	3	3	N	3	3	N	N	3			
11 Jason	3	3	3	3	3	3	3	3	3	3	3	3			
12 Kidslink	3	3	3	3	3	3	3	3	3	N	3	3			
13 S.D.HP	3	N	N	N	3	N	3	3	3	2	3	3			
14 S.E.D.S.	3	3	3	3	3	3	3	3	3	3	N	3			

Key:
A Learning to Learn skills (critical thinking, quantitative reasoning, effective communication)
B Mentoring Process (working one-on-one; student setting individual goals; helping students muse and question)
C Project Centered (hands-on)
D Interdisciplinary and integrative
E Current and real-life problems
F Collaborative (student-to-student, student-to-mentor; possibility for cross culture collaboration)
G Discovery Learning (student actively constructing own database, student coming to own conclusions)
H Use of student's own learning style
I Access to wide variety of resources (databases, opinions of many, etc.)
J School linkages to universities, scientific labs, etc.

K Dissemination of students work (student's ability to upload as well as download)
L Intrinsic motivation (motivation from work not from meeting adult expectation and getting grades)

Rating Scale:
0 None
1 Low Use
2 Medium Use
3 High Use
N Not applicable
? Unknown