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The Day After Net Day: Approaches to Educational Use of the Internet

ABSTRACT

To date, popular enthusiasm for educational applications of computer networking has outpaced scholarly research on their educational value. This article reviews a variety of approaches to educational use of the Internet, and divides them into four categories: information delivery, information retrieval, information sharing, and technological samba schools. Pedagogical foundations of each approach are analyzed. As we move through these approaches in order, the emphasis shifts from information to ways of knowing, and there is an increasing emphasis on community.

1. The Hype and the Reality

In the United States on Saturday, March 9th, 1996, volunteers filled California schools to wire them for Internet access. As many as 150 volunteers showed up at some schools. It was a high-visibility event—even America's president and vice president joined in: "Donning electrician's gloves and hopping on a ladder, President Clinton joined the cyberspace revolution Saturday as he worked with Vice President Al Gore to install about 70 feet of pink, white and blue conduit at a Contra Costa County high school," wrote the San Jose Mercury News (SJMN 1996). The organizers of the event, dubbed "Net Day," reported that over 18,000 volunteers participated.

The day after Net Day, teachers were left with questions: Now what? What exactly are we supposed to do in our classrooms with this new technology? Contrast the utopian hype surrounding Net Day to this letter to the editor published in *The Boston Globe* a few months later:

> "Massachusetts schools should consider themselves fortunate to be in 48th place ("A Net gain for schools," editorial, May 28). Having just spent more than two frustrating weeks trying to get on and use the Net, I can assure teachers that it is one of the greatest wastes of time ever foistered upon the public. Not only is it hard to find the place you're looking for, but when you finally get there the information you hoped to find is not available or of limited value. The main purpose seems to be to amuse browsers who have unlimited time with sluggishly transmitted, cute pictures and endless alternatives to "click on." The only benefactors from wiring up the schools will be

> equipment sellers, installers, and the inevitable service providers." (Kleinschmidt 1996)

The positive and negative hype are equally comic. The letter's author has little idea how one might use the Internet in an educational setting. However, in a sense, no one does—the possibilities are still being explored. In the popular press and the popular imagination, the net functions largely as a symbol.[1] In the positive hype: "The net is the future. The net is progress. If your child is using the net, then he or she is part of the future; your child will be a success." In the negative hype: "The net is technology. Technology has cheated us before and is trying to cheat us again. Technology will bring us no real benefits. The net is not just a waste of time and resources—it is diverting us from the core values that really matter." In the past, other technologies have played this symbolic role. In the 1980s, computers in general tended to symbolize the future; in the late 1990s, people are more likely to use the net as that symbol. The role of symbolizing the future is constantly migrating to a newer technology. If the net functions as a symbol, children function as an even more powerful symbol: "Children are the future. Children are innocent, pure, and impressionable." The combination of these two symbols, children using the net, is a cultural powder keg. When people debate the issue they are often really debating their hopes and fears for the future—their personal future as well as the future of our society.[2] The reality, the real things people are doing in classrooms with children and net connections, is much more pedestrian.

One common mistake is to think of the net as one thing. Students and educators use computer networks in a wide variety of ways. Each approach is rooted in different educational traditions. Broadly speaking, you can put educational uses of the net in four categories: distance education, information retrieval, knowledge-building communities, and technological samba schools (See Table 1). In the rest of this article, I'll discuss each approach in turn. As we move from approach I to IV, the emphasis shifts from information to ways of knowing, and there is an increasing emphasis on community. There is also a shift from more curriculum-centered approaches to student-centered approaches. The particular projects selected for discussion were chosen to highlight different pedagogical approaches. The list is far from comprehensive.

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[1]See (Arnold 1995) for a discussion of ways in which the Logo programming language functions as a symbol for a particular progressive educational tradition.

[2]In 1997 I met with an educator from a third-world nation, and invited her to arrange for some children from her country to join MOOSE Crossing. The coordinator of her visit sent me a very nice thank-you note which commented that "She was especially interested in the

EDUCATIONAL APPROACHES TO USING THE NET		
I.	**Distance Education**	
	Tradition:	Examples:
	Instructionism	The Open University
		IBM in China
		Diversity University
II.	**Information Retrieval**	
	Tradition:	*Examples:*
	Exploratory Learning	Net surfing
		Research projects
III.	**Knowledge-Building Communities**	
	Tradition:	*Examples:*
	Collaborative Learning	Global science
		CSILE
		Professional communities
		Computers & writing
IV.	**Technological Samba School**	
	Tradition:	*Examples:*
	Constructionism	The Computer Clubhouse
		MicroMUSE
		Pueblo
		MOOSE Crossing

Table 1: Educational Approaches to Using the Net

2. Distance Education

Long before computers were invented, people were learning from home via correspondence courses. For the geographically isolated and for adult learners juggling the demands of work and family, distance education has provided otherwise impossible opportunities. Britain's Open University currently serves the needs of 200,000 students. Their web page (*http://www.open.ac.uk/*) notes that "The oldest graduate so far was 93, while the youngest student is a nine-year-old prodigy taking maths. There are roughly equal numbers of men and women. About three-quarters of students remain in full-time employment throughout their studies."

The tradition of distance education (like much of education in general) is rooted in "instructionism." An instructionist approach to education focuses on the transmission of information from teachers to students. Students are expected to master a curriculum-specified set of facts, and be able to repeat those facts on examination. Mastery of information is often emphasized over ways of thinking and knowing. Most commonly, distance education students receive a set of materials to study, and then take tests to demonstrate their mastery of that information.

Clearly missing from this model is classroom interaction. The Open University has worked hard to counteract this problem by setting up local networks of tutors and regional centers around the United Kingdom. They are currently beginning a major initiative to use computer networks to provide access to information and enhance interaction among students and teachers. Unfortunately, many other distance education programs do not live up to the Open University's high standards.

Many distance education projects are experimenting with video conferencing techniques. An expert's live presentation can be sent to thousands of students. Students can ask questions from remote locations. Questions and answers can be broadcast to all students participating. Proponents argue that students who would normally have access to only inexperienced teachers are now being taught by world-class experts. Underlying this argument I believe is a fundamental misunderstanding of what it means to be a good teacher, and a lack of respect for the teaching profession. Consider the combinatorics of the situation: if one expert is lecturing to hundreds or thousands of students, there will be time for only a tiny percentage of those students to ask questions. The entire presentation is then equivalent to students learning from watching a videotape. How would one compare learning from videotapes of experts to learning from a good teacher? Ideally, the teacher establishes a relationship with each student, getting to know him or her individually. The social and psychological dimensions of those relationships are as important as any role the teacher may play in supplying information or assessing students' performance. The teacher tailors the learning experience to meet students' needs, rather than being tied to a fixed curriculum. The teacher's role varies in different pedagogical traditions, but across all of those traditions one thing is clear: good teaching is an art.

In early 1996 I met with a development team from IBM that was working on just this sort of solution for China—piping video into classrooms across computer networks. They argued that the quality of teaching in China is generally horrible and the number of learners so immense that this sort of network was an appropriate solution. This is not only a waste of scarce financial resources, but also could be actively harmful to the educational process if teachers perceive the lack of respect for their skills and their efforts that motivated this system design. Instead of dismissing those teachers as incompetent, why not invest resources in teacher training and professional development? That would bring more benefit to students than talking-head video presentations. (See Section 4.3 for more on supporting teachers.) Roy Pea writes:

> When researchers see distance learning projects using satellites or fiber optic cables for reproducing the lecture through remote audio-visual telephones, we are worried. With minimal participant interactivity, we are as concerned about students' prospects for learning as many critics rightfully were when educational television emerged. For these distance learning projects primarily allow the remote chaining of classrooms to accomplish distributed traditional lectures. The teacher is physically separate from some or all of the students. The lecture is broadcast to one or more remote classrooms. In most situations, video communication is one-way from the teacher. Students ask questions and otherwise interact with instructors via audio callback channels. In rare cases, teachers have two-way audio and video. But even then, it is the teacher with control over which remote class is seen and heard. Current distance learning systems and prototypes do not have facilities for small group interaction. Teachers cannot interact with a small group of students to the exclusion of others. Similarly, students who use these systems cannot establish small, remote, in-class

> collaborative learning teams to work on some aspect of problems at hand. For the most part, data is not integrated into the distance-learning experience. Remote students may see examples projected on monitors, but they cannot interact with these examples at the board. The teacher can ask multiple-choice questions and students can respond yes or no with a remote control. Only crude approximations of learners' understandings can be attained in this manner. The bandwidth for transformative communications is considerably reduced from the possibilities in proximal physical learning environments. (Pea 1996).

A more interactive use of technology to support distance education involves the use of mailing lists, real-time chat, and MUDs to foster interaction among students and teachers on a reasonable scale. Since these technologies are many-to-many instead of one-to-many, they afford more real interaction. For students taking classes at The Open University, these technologies are providing new opportunities for students to learn from one another.

At a MUD called Diversity University (*telnet://erau.db.erau.edu:8888*), students sit at virtual desks in virtual classrooms. The designers have tried to move the classroom environment into text-based virtual reality, complete with programs to simulate white boards and white-board erasers. Since the nonverbal cues that help people negotiate whose turn it is to talk are absent, many classrooms include software to programmatically control turn-taking. While this approach is certainly preferable to talking-heads videos, it is still far from ideal.

Distance education often uncritically gives us a bandwidth-impoverished literal-minded copy of the traditional classroom. In most of these projects, the metaphor of having a virtual space is being taken too literally. Virtual classrooms are not simply mediated forms of real classrooms. To treat them as such is akin to early filmmakers who pointed cameras at theatre stages and produced essentially filmed plays. Virtual spaces are a new medium whose properties need to be explored and used to their best advantage. More ambitiously, this new technology can be used not merely to reproduce traditional education, but to help reform it. New educational technologies can provide opportunities to introduce new educational ideas. Most distance education projects simply translate an old medium (the classroom) into a new one (virtual space) without reflecting on either what the new medium is good for or how the old medium needs to be reformed.

3. Information Retrieval

When members of the general public think about children using the Internet in school, they often assume, as did the author of the letter to *The Boston Globe* (quoted in Section 1), that the children will be "surfing" the net for information. From this perspective, teaching children about the Internet is the modern equivalent of classes in library skills. Learning how to find information online is a useful means to an end—not an end in itself.

Using the Internet as an electronic library has a number of pedagogical benefits when used in combination with (not instead of) other information sources. The volume of information available exceeds that possible within a school library, and much of that information is more current than is possible in printed books. It's significant that on the Internet, all schools—rural and urban, rich and poor—gain access to the same quantity and quality of information (except where filters are imposed to protect the children from controversial information.) However, it is not clear that it's of central importance for students to have access to the latest information; most school libraries are more than adequate for students' needs. On the other hand, the idea that they have access to the latest information has the potential to get kids more excited about what they are researching. Students often feel condescended to by schools and school text books. By giving them access to "real" information sources used by adults, they can be made to feel that they are being taken seriously, and they may consequently take the educational process more seriously themselves.

Many express concern that much of the information available online is not accurate. While this is a problem, it also has a hidden benefit. Children are taught not to believe everything they hear, but they are not urged strongly enough to question everything they read. The network brings issues of point of view and reliability into high relief. It's likely that children raised using electronic information sources will learn to be more critical consumers of all information, particularly if given appropriate guidance.

At its best, information retrieval activities are a form of exploratory learning: children research a topic they care about in depth. They evaluate the information they discover critically. The research culminates in a report or other project. At its worst, information retrieval can become a kind of trivial pursuit game. In a classroom I once visited, students were challenged to find the names and dates of the largest volcanic eruptions in history. This wasn't presented as part of a larger curriculum unit on volcanoes—the information was not situated in any meaningful context. It was merely an academic scavenger hunt. Thoughtful uses of electronic information retrieval in the classroom have more to do with traditional research projects than with "net surfing."

3.1 Children Accessing Controversial Information

A complicated and troubling issue raised by use of the Internet for information retrieval concerns children's potential access to controversial information online. A tremendous volume of obscene, racist, and violent information is available online. While such information generally appears only when one actively looks for it, it is possible to stumble on it accidentally, as one of my students did some time ago. MOOSE Crossing is a text-based virtual world (or "MUD") designed to be a constructionist learning environment for children (Bruckman 1997). Children create magical places and objects that have behaviors out of words and computer programs. (MOOSE Crossing will be discussed in more detail in section 5.) One of MOOSE Crossing's first sample programs was an elephant that tells elephant jokes. A twelve-year-old boy using MOOSE Crossing at The Media Lab wanted to make a lawyer who tells lawyers jokes. He asked one of the adults present if it was OK for him to open up a web browser to search for lawyer jokes. I was working with children on the other side of the room, and heard about this a few minutes later. Something troubled me about it, but I wasn't immediately sure what. I was surrounded by kids asking for my help, and didn't stop to give the matter my full attention right away. Ten minutes later when things had quieted down, it occurred to me: the last time I saw a joke collection posted to the web, many of the jokes were dirty ones. Looking over the student's shoulder, my fears were proved correct—the joke collection he was reading was largely obscene. I had a talk with him about the responsibilities that come with the privilege of net access, and the reasons why many people don't want their children to see such material. Whether any real harm was done depends on your perspective.

I've told this story to a number of adults who have chuckled and laughed it off—there's no real harm in a dirty joke or two, is there? There are two problems with this argument. First, not all parents agree. Some would find the fact that their child had been exposed to a dirty joke to be a very serious matter. Second, the level of obscenity in some materials available on the net exceeds what you might guess—the lawyer joke collection in question included anal sex jokes. While I believe our culture would benefit from more open discussion of human sexuality, the fact remains that such subjects should be broached at an appropriate time and in an appropriate context. A student actively seeking such information should be able to find it, but he or she shouldn't stumble across it while looking for lawyer jokes.

There are a wide variety of strongly-held opinions on this issue. In March of 1995, Michele Evard and I founded an email discussion list on Children Accessing Controversial Information (caci). We led a round-table discussion on the topic at the April 1995 meeting of The American Educational Research Association (AERA). On the caci list, the topic was sufficiently controversial to generate a high volume of messages, and a high level of emotional tension. Many participants presented their views with absolute certainty, refusing to acknowledge the merit of other people's points of view. On one side, some people argued that freedom of speech and the freedom to read are absolute, and any restrictions are a violation of basic human rights. On the other side, some people declared that children finding inappropriate information online would be nothing less than tragic, and must be prevented at all costs. After several months, we found a volunteer to take over the list management, and I unsubscribed from the list. The repetitive nature of the conversation and its self-righteous tone were more than I could stomach. Many people feel strongly about this issue.

In March of 1996, I organized a session at MIT's Communications Forum entitled "Protecting Children/Protecting Intellectual Freedom Online." Judith Krug, Director of the Office for Intellectual Freedom at The American Library Association, and Bill Duvall, President of SurfWatch Software, spoke. Krug spoke eloquently about the importance of intellectual freedom. However, in her insistence that the freedom to read is absolute, she failed adequately to acknowledge that libraries do make editorial decisions in what books they choose to buy. Duvall presented his company's SurfWatch software, which gives parents the option to filter out controversial information. SurfWatch uses a combination of keyword filtering and ratings by human reviewers to filter out sexually explicit content. It does not filter violent or racist content, and parents can in no way tune the software to match their values. While Duvall made a good case for the value of empowering parents to make choices for their children, he failed to address the issue of the competing rights of children, parents, school systems, and the broader society. For example, should teenagers be able to access information about gay teen support groups if their parents and school system don't want them to? Does a local school district have the right to ban access to information about evolution if the broader society believes it to be an important scientific fact? None of these issues are new; the Internet simply gives them a new immediacy.

SurfWatch is only one of a growing number of products designed to make net access more appropriate for kids. There's also Cyber Patrol, Net

Nanny, SafeSurf, and others. Some of these systems use an underlying standard called PICS (the Platform for Internet Content Selection), a protocol that supports not only multiple ratings of content but multiple ratings systems (Resnick and Miller 1996). While PICS has promise, all attempts at technological solutions to fundamentally social problems have limitations. The most useful analogy I've come across is that the Internet is a city. You don't let a very young child go into the city alone, but you might let them play alone in the yard. (In this scenario, communities like MOOSE Crossing are like loosely supervised playgrounds.) As children grow older, you need to educate them on how to be street smart. Eventually, you need to trust them to venture off on their own and use good judgment. The Internet brings some of the complexities of the real world onto your desktop. Parents need to stay involved to help children learn to negotiate those complexities.

4. Knowledge-Building Communities

Distance education focuses primarily on information delivery. Information retrieval is in a sense the opposite process. Knowledge-building communities focus on information *sharing*. Distance education is probably most closely allied with the behaviorism of B.F. Skinner (Skinner 1968) and information retrieval at its best is allied with the exploratory learning of John Dewey (Dewey 1938), Knowledge-building communities are more closely linked to the work of Lev Vygotsky (Vygotsky 1978). Vygotsky emphasized the social, collaborative nature of learning.

4.1 Global Science

The most common kind of knowledge-building community is what I have dubbed "global science" (See Table 2). In the TERC/National Geographic Acid Rain Project (now part of the Global Lab Project), children around the world record data about acid rain in their area. By sharing the data, they are able to gain an understanding of this global phenomenon. Similarly, in The Journey North, children from Mexico to Canada collaborate to track animal migration patterns. In the Kids as Global Scientists project, children collaborate to study weather patterns (Songer 1996). The Jason Project has a slightly different emphasis. In the Jason Project, marine biologists from Woods Hole Oceanographic Institute explore undersea phenomena with a small remote-controlled submarine. Children can see video output by the sub, and take turns controlling it remotely. The goal is for the children to develop a sense of having participated in a "real" scientific investigation. These are just a few of the many "global science" projects on the Internet.

Not all of these projects qualify as educational research—some are publicity rather than result driven, a common disease in this era of Internet hype. When I approached some of these "global science" projects asking for a list of publications, they confessed that they had none, or in some cases sent press clippings in place of research studies. Nancy Songer's work in the Kids as Global Scientists Project is among the most methodologically sound in this area of research.

Songer compared learning outcomes for a class of students discussing weather data with other schools over the Internet, and a control group doing research in their school library. While the quality of scientific data collected was comparable between the two groups, "Internet responses focused on a mixture of scientific and personal information, such as personal anecdotes or familiar occurrences in local weather patterns." The Internet students had become more personally involved with the project. Teachers observed that their Internet students had increased motivation to learn about the weather (Songer 1996).

"GLOBAL SCIENCE" PROJECTS
• TERC/National Geographic Acid Rain Project (Global Lab) *http://globallab.terc.edu/*
• The Jason Project *http://www.jasonproject.org/*
• The Journey North *http://www.ties.k12.mn.us/~jnorth/index.html*
• Kids as Global Scientists *http://onesky.engin.umich.edu/*
• The Noon Observation Project *http://www.ed.uiuc.edu/Projects/noon-project/*

Table 2: "Global Science" Projects

In The Noon Observation Project, students repeat an experiment first performed by Erasthones in Ancient Greece: measure the length of a shadow at noon at several distant locations, and you can estimate the circumference of the earth. The study organizers write:

> In order to learn about the role that the network played in this project, let us consider whether such a project could have been done without an electronic network. In terms of conducting a project which provides a practical context for mathematics skills, the class could have gone out and used their meter stick shadows and the shadow of the school's flagpole to determine the height of the flagpole, as mathematics teachers have done for generations. However, the network seemed to provide a highly motivating context for learning, both for the students and for the teachers involved. More specifically, it provided support in the following ways: 1) as a source of ideas, 2) as a supplier of tools, 3) as a source of diverse data, and 4) as a diverse audience (Levin, Rogers et al. 1989).

Perhaps the most important of these criteria is the notion of audience. In The Instructional Design Software Project, Idit Harel had fourth grade students write software to teach third graders about fractions (Harel 1991). Harel notes that the educational benefit goes entirely to the fourth graders—the third graders learn little if anything from the experience. However, the notion of having an audience restructures the fourth graders' relationship to the design process. Students become more excited about the project and take pride in the quality of their work, because they are designing for an audience they care about. The same phenomenon can be observed in global science research projects: the idea of sharing their data with an audience of their peers is motivating, and encourages students to do quality research. Given the typically limited nature of the interaction among students in these projects, it is often the idea of having an audience that is beneficial, more than the actual interaction with that audience that takes place.

In a knowledge-building community, ideally students should critically debate issues that arise. In most of the global science projects, such debate rarely occurs. When kids pose questions of students at other locations, those questions often go unanswered (Songer 1996). Many projects don't even allow kids to discuss issues that arise with one another. Instead, each class sends data in to a central authority, and the central authority does all the work of aggregating, evaluating, and presenting the data. Their conclusions are sent back to each classroom. In many ways, the organizers are engaged in a more powerful learning experience than the students. Children are serving more as technicians than scientists. Songer is exploring giving participating schools access to data analysis software, so that the analysis is done locally rather than by a centralized authority. This is a promising strategy to improve the amount students learn from the "global science" experience.

4.2 CSILE

Compared to most projects of this kind, more reflection and critical debate about issues has been achieved in the CSILE (Computer-Supported Intentional Learning Environment) project. CSILE is a networked bulletin board system which structures discussions into notes and comments on those notes. Typically, a class will jointly investigate a topic. Rather than have each student complete the same assignment, students take responsibility for different aspects of the over-arching topic. The goal is to reproduce the character of scientific inquiry in a community of scientists. The designers of CSILE write:

> Can a classroom function as a knowledge-building community, similar to the knowledge-building communities that set the pace for their fields? In an earlier era, it would have been possible to dismiss this idea as romantic. Researchers are discovering or creating new knowledge; students are learning only what is already known. By now, however, it is generally recognized that students construct their knowledge. This is as true as if they were learning from books and lectures as it is if they were acquiring knowledge through inquiry. A further implication is that creating new knowledge and learning existing knowledge are not very different as far as psychological processes are concerned. There is no patent reason that schooling can not have the dynamic character of scientific knowledge building. (Scardamalia and Bereiter 1994)

CSILE is most commonly used on a local-area network, but it can be used across the Internet. CSILE or a tool like it might help organizers of global science projects to foster more reflection and critical debate among participants.

4.3 Professional Communities

While CSILE strives to give children in the classroom an activity like those of a community of adult researchers, much is being done with network technology to support actual adult research communities. This has long been the activity of a myriad of professional societies like the Association for

Computing Machinery (ACM). Such societies were early adopters of email and bulletin board technologies. A great deal can happen between annual conferences. Computer networks can accelerate the pace of debate of issues, and offer individuals ongoing support in their endeavors.

PROFESSIONAL COMMUNITIES

- AstroVR
  For: Astrophysicists
  Address: *http://astrovr.ipac.caltech.edu:8888/*
- ATHEMOO
  For: Theatre professionals
  Address: *telnet://moo.hawaii.edu:9999*
- BioMOO
  For: Biologists
  Address: *http://bioinfo.weizmann.ac.il/BioMOO*
  telnet://bioinformatics.weizmann.ac.il:8888
- MediaMOO
  For: Media researchers
  Address: *http://www.cc.gatech.edu/~asb/MediaMOO/*
  telnet://mediamoo.cc.gatech.edu:8888
- Tapped In
  For: Teachers
  Address: *http://www.tappedin.sri.com/*
- The Tuesday Café
  For: Writing teachers
  Address: *http://bsuvc.bsu.edu/~00gjsiering/netoric/*

Table 3: Professional Communities Situated in MUDs

A number of communities are now supplementing face to face meetings and mailing lists with online communities in MUDs. The first two communities to use MUDs for this more "serious" purpose were AstroVR (for astrophysicists) (Van Buren, Curtis et al. 1994) and my own MediaMOO (for media researchers) (Bruckman and Resnick 1995).[3] Compared to mailing lists, a MUD facilitates more casual collaboration. I am unlikely to send email to a colleague I've never met saying "I hear you do work in education. I'd like to hear more about it," but I might say exactly that if I bumped into them in a public space online. MediaMOO functions rather like an endless reception for a conference on media studies.

There are a growing number of such communities. ATHEMOO is a community for theatre professionals; BioMOO is for biologists (Glusman, Mercer et al. 1996). Of particular interest are online communities of teachers. A group of writing teachers met every Tuesday night in The Tuesday Café to

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[3]AstroVR began development first, and was the inspiration for MediaMOO; MediaMOO actually opened to the public first, because less specialized software development was

talk about how to use computers to teach writing (Fanderclai 1996). The Tuesday Café was located on MediaMOO from 1993 to 1997, and since then has moved into its own space. Organizers Tari Fanderclai and Greg Siering choose a topic each week, and 15 to 60 teachers generally attend. Past topics have included the portfolio approach to writing instruction, how to equip a writing lab, and "students and the underside of the net." Most writing teachers are under-paid, over-worked, and geographically isolated. The Tuesday Café helps them to take the process of reflecting on their practice from an annual to a weekly event. Online meetings complement face to face meetings and ongoing mailing list discussions. Tari Fanderclai writes:

> As with asynchronous forums, I am connected to people who share my interests, but MUDs provide something more. For example, the combination of real-time interaction and the permanent rooms, characters, and objects contribute to a sense of being in a shared space with friends and colleagues. The custom of using one's first name or a fantasy name for one's MUD persona puts the inhabitants of a MUD on a more equal footing than generally exists in a forum where names are accompanied by titles and affiliations. The novelty and playfulness inherent in the environment blur the distinctions between work and play, encouraging a freedom that is often more productive and more enjoyable than the more formal exchange of other forums. It is perhaps something like running into your colleagues in the hallway or sitting with them in a cafe; away from the formal meeting rooms and offices and lecture halls, you're free to relax and joke and exchange half-finished theories, building freely on each other's ideas until something new is born. Like the informal settings and interactions of those real-life hallways and coffee shops, MUDs provide a sense of belonging to a community and encourage collaboration among participants, closing geographical distances among potential colleagues and collaborators who might otherwise never even meet. (Fanderclai 1996)

Researchers at SRI are currently developing an online community for teachers called Tapped In (Schlager and Schank 1996; Schlager and Schank 1997). While researchers at IBM are trying to use computer networks to replace teachers or work around them (see Section 2), researchers at SRI are using networks to support them, helping them to become better teachers. Organizers Mark Schlager and Patricia Schank write:

> Researchers, policy-makers, and educators view teacher professional development as a critical component of educational reform. One approach that embodies this kind of experience is the specially designed professional development institute that brings educators together around a theme or set of topics to acquire new skills and knowledge in a collaborative venue. Teachers engage in meaningful discussion with peers over several days or weeks, while interacting with a rich collection of resources. However, it is difficult to (a) scale special institutes to accommodate the large education community and (b) maintain the level of discourse and support established at the institute. Back in the classroom, teachers are once again isolated from their professional community.

> Our goal is to build on the strengths of these successful same-time, same-place professional development models by employing multi-user virtual environment (MUVE) technology to sustain and enrich the professional discourse, while extending access to greater numbers of educators. In service of this goal, we are developing a MUVE-based Teacher Professional Development Institute (TAPPED IN). The mission of TAPPED IN is to promote and support K-12 education reform through the establishment of a community of education professionals that is not exclusionary by virtue of geography, discipline, or technology requirements. Following exemplary teacher enhancement institutes, TAPPED IN will offer both formal events (e.g., inservice workshops, presentations) and informal ongoing activities (e.g., teacher collaboratives, case study discussion groups, apprenticeships) that teachers can access during free periods or after school. TAPPED IN will also offer services such as library facilities, bulletin boards, and e-mail. Finally, TAPPED IN is a research project intended to investigate the ways in which text-based, immersive environments initiate and sustain the growth of professional communities. (Schlager and Schank 1996)

Online professional communities are exemplary knowledge-building communities. One important difference between professional communities and knowledge-building communities organized as school activities for children is that the adults have their own goals. Too often, children have educational goals imposed upon them. It would be beneficial to work towards helping students to identify their own learning objectives. Knowledge-building communities for children can learn a great deal from professional communities for adults.

4.4 Real-Time Writing

One of the earliest uses of a text-based chat system as an educational tool was with deaf students. At Gallaudet University in 1985, Trent Batson and Steve Lombardo taught a class entirely on the computer. They called this experiment "English Normal-Form Instruction." For young deaf children, English "is an experience largely limited to the classroom and lacking real-life connections"(Batson 1993). There is no mutual reinforcement between the written and the spoken word, as there is for hearing children. Using a real-time chat system in the classroom, Batson and colleagues found that they could make writing come alive:

> With a computer network and software that allows for interactive writing, deaf students can use written English not simply to complete grammar exercises or to produce compositions to be evaluated, but also to spontaneously communicate ideas that are meaningful to them with a community of other writers who are interested not in evaluating, but rather in understanding what they are saying. Written English can be used to joke and play with language, to discuss literature or serious social issues, to brainstorm ideas or collaboratively produce a draft for a paper, and to critique writing in progress. In short, written English can be used in many ways that oral English is used by hearing people. (Batson 1993)

The results of this experiment were so successful that writing teachers realized it would be beneficial for hearing students as well. Chat systems are particularly useful for helping novice writers to understand the notion of audience. Writing online, it becomes quite clear that you are writing *for someone* and need to tailor your writing to that audience. Advocates of this approach to writing instruction re-appropriated the acronym ENFI to mean "Electronic Networks for Interaction" (Bruce, Peyton et al. 1993).

A large community of teachers and researchers is continuing to explore the educational use of chat systems and MUDs for writing classes. A group of researchers at The University of Texas at Austin began developing their own software, and soon spun off a company, The Daedalus Group, to continue its development. Their product, Daedalus Interchange, is in use in a large number of schools. The computers and writing community enthusiastically uses the Internet both as an educational environment for their students, and to help themselves reflect on their practice as teachers.

No one would ever think to teach writing by lecturing to students—writing teachers have students write. While in other fields educators are struggling to increase the emphasis on learning by doing and learning through design, in writing instruction these principles have long been absolutely accepted. However, that does not mean that all pedagogical questions are answered. If learning should be self-motivated and self-directed, what do you do with students who don't want to learn? Does feedback from peers help students to become better writers, or do egos just get in the way? What power relationships exist in the classroom and how do those affect the learning process? Should we encourage students to find their own expressive style (because that is more personally meaningfully), or to conform to society's standards (because that is more economically empowering in the realities of the job market)? Who decides what constitutes "good writing"? The computers and writing community is ahead of most other communities of teachers and researchers in their exploration of many critical questions.

5. Technological Samba Schools

The approaches discussed so far have been focused to varying degrees on information—delivering it, retrieving it, and sharing it. This essay is organized roughly in order of decreasing emphasis on information and increasing emphasis on community and the social context of learning. The last category of projects I call "technological samba schools," a term introduced by Seymour Papert in his 1980 book *Mindstorms* (Papert 1980). At samba schools in Brazil, a community of people of all ages gather together to prepare a presentation for carnival. "Members of the school range in age from children to grandparents and in ability from novice to professional. But they dance together and as they dance everyone is learning and teaching as well as dancing. Even the stars are there to learn their difficult parts" (Papert 1980). People go to samba schools not just to work on their presentations, but also to socialize and be with one another. Papert imagines a kind of technological samba school where people of all ages gather together to work on creative projects using computers.

In Papert's vision of a technological samba school, learning is:

- self-motivated,
- richly connected to popular culture,
- focused on personally meaningful projects,
- community based

- an activity for people of all ages to engage in together,
- life long—experts as well as novices see themselves as learners, and
- situated in a supportive community.

Projects like The Computer Clubhouse at The Computer Museum in Boston seek to create samba-school-like communities. Kids can drop by The Computer Clubhouse after school to work with a variety of educational technologies. Mitchel Resnick and Natalie Rusk contrast The Computer Clubhouse to other projects providing community access to computers:

> The Computer Clubhouse (organized by The Computer Museum in collaboration with the MIT Media Laboratory) grows out of this tradition, but with important differences. At many other centers, the main goal is to teach youth basic computer techniques (such as keyboard and mouse skills) and basic computer applications (such as word processing). The Clubhouse views the computer with a different mindset. The point is not to provide a few classes to teach a few skills; the goal is for participants to learn to express themselves fluently with new technology, becoming motivated and confident learners in the process. At the Clubhouse, young people become designers and creators—not just consumers—of computer-based products. Participants use leading-edge software to create their own artwork, animations, simulations, multimedia presentations, virtual worlds, musical creations, Web sites, and robotic constructions. (Resnick and Rusk 1996)

Real samba schools and The Computer Clubhouse are physical places. People gather there both to work on their projects and to socialize with one another. The architectural space serves as a community center for the members, providing a context for both organized activity and more casual interaction.

However, not all children live near a place like The Computer Clubhouse. Even for those who live near by, not all parents are willing to take the time to bring their children there. Only a few institutions (typically community centers and housing projects) have the resources to bring kids to The Clubhouse after school on buses. As a result, most of the members are high-school-age children who can get there via public transportation. Logistical issues have unfortunately made the clubhouse less accessible to younger children.

The development of the technology of "virtual spaces" has the potential to make the idea of a technological samba school more feasible. While virtual interaction can never replace face to face interaction, network technology can be used to create communities in which people have meaningful inter-relationships, and many of the benefits of samba schools become possible. Like physical spaces, virtual spaces can provide a context for interaction among groups of people. While children don't need to travel to get to a virtual space, they do need access to a computer with a net connection. One factor limiting participation is unfortunately replaced by another.

It's worth noting that physical and virtual clubhouses are not mutually exclusive approaches. Many kids at The Computer Clubhouse participate in MOOSE Crossing. This gives them an opportunity to interact with other children not from their immediate geographic area. Interaction among members in the room is complementary to interaction with children at remote locations.

Calling a networked communications technology a "place" is a metaphor that helps to give participants shared expectations for how to interact with that technology, and with one another, mediated by that technology. When most people approach a computer running a piece of software, their expectations are shaped by the genre of software they are about to use. Is it a drill and practice program? Is it a spreadsheet? Is it a game? Calling a software system a "place" gives users a radically different set of expectations. Places have strong cultural associations. People are familiar with a wide variety of types of places, and have a sense of what to do there. Instead of asking "What do I do with this software?", people ask themselves, "What do I do in this place?" The second question has a very different set of answers than the first. Metaphorically calling an electronic communications medium a place lets people use their knowledge of places to help understand that communications medium. A spatial metaphor helps to create a context for the mix of playing, socializing, and learning desirable in a technological samba school.

MUDs are particularly well suited to creating technological samba schools because of their spatial metaphor, and the ways they can facilitate expressive use of words and programs. The virtual world itself is created by the members. The activity of the community becomes creating the community itself.

However, not all MUDs share qualities with samba schools. Most are violent adventure games that share few of these qualities. Even "educational" MUDs usually don't fit into this paradigm. There has been an explosion in the number of educational MUDs[4], and they represent a wide variety of pedagogical traditions. Many educational MUDs have virtual classrooms with virtual desks and virtual whiteboards where students politely raise their virtual hands to ask questions during virtual lectures. This approach is closest to distance education (discussed in Section 2). Other educational MUDs are experimenting with creating virtual science simulations. Such simulations could be used in a variety of ways which match with different pedagogical traditions; however, the development of this technology is in such an early state that it's not clear if any pedagogical goals are being met at all. More research is needed to evaluate its potential.

Unfortunately, MUDs are currently being used in some projects that would be better off without them. An old sophomoric joke is to take the fortune from a fortune cookie and add the words "in bed" after it. Some researchers today seem to be taking their research proposals and adding the words "in a MUD" after them. This uncritical enthusiasm is unfortunate. MUDs and other forms of virtual reality technology have educational potential when used in the context of a solid pedagogical approach, and when used to take advantage of the affordances of the particular technology being used. For example, current MUDs afford the expressive use of words and computer programs. This makes them well suited to language-oriented applications such as deaf education, writing instruction, foreign language

[4]There are many lists of educational MUDs on the net, but none of them is comprehensive or entirely up to date. The list I have found most useful is maintained by Daniel K. Schneider <Daniel.Schneider@tecfa.unige.ch> at:

classes, and English as a Second Language (ESL) (Bruce, Peyton et al. 1993). They are also well suited to educational projects specifically about programming and other aspects of computer science. There is not yet suitable support for science simulations in MUDs in either the technology or the pedagogy—the technological infrastructure needed is not yet developed, and there are many unanswered pedagogical questions about the value of learning through simulation versus through "real" experimentation.[5] Technology can be a catalyst for meeting educational goals if the goals are put first in the design process, and technology is used appropriately to help meet those goals. All too often, the design process proceeds in the other direction, starting with what the technology can do and searching for an application.

TECHNOLOGICAL SAMBA SCHOOLS

- The Computer Clubhouse
  http://www.tcm.org/resources/
- MicroMUSE
  http://www.musenet.org/
- MOOSE Crossing
  http://www.cc.gatech.edu/~asb/moose-crossing/
- Pueblo (formerly MariMUSE)
  telnet://pueblo.pc.maricopa.edu:7777

Table 4: "Technological Samba Schools"

Three MUD projects that stand out as samba-school-like are MicroMUSE, Pueblo (formerly MariMUSE), and MOOSE Crossing. In each of these communities, children are encouraged to learn in a constructionist fashion—through working on self-selected, personally meaningful projects. This generally consists of extending the virtual world by making new places and objects.

MicroMUSE, the oldest and largest MUD for kids, has been open since 1990 and as of January 1997 had 800 members, of whom approximately 50% were children (Kort 1997). MicroMUSE was originally founded by then college student Stan Lim (Brown 1992; Kort 1997). Researcher Barry Kort stumbled on the community early in its development, and helped to shape its educational mission. MicroMUSE is also called "Cyberion City," and is modeled as a city of the future. Navigation around the world is done in radial coordinates. The virtual world contains a number of science simulations, and scientific themes are emphasized.

MariMUSE opened originally as a summer camp activity for children organized by Phoenix College researchers Billie Hughes and Jim Walters. They chose to work with students from Longview Elementary, a school whose population is 34% Hispanic and 21% Native American. A significant

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[5]This question is currently being addressed by Mitchel Resnick, Robert Berg, Michael Eisenberg, and Sherry Turkle in their NSF project "Beyond Black Boxes: Bringing

portion of Longview students have limited English proficiency. Over the summer of 1993, Hughes and Walters brought children from Longview to Phoenix College for two summer sessions, each three-weeks long. Children used MariMUSE for three hours each day. The MUSE activity was particularly successful with the "at risk" students participating, several of whom appeared to develop a greater confidence in their abilities and interest in learning that carried over into the following school year (Hughes and Walters 1995; Hughes 1996; Hughes and Walters 1997).

Results from this initial summer program were sufficiently encouraging that Hughes and Walters arranged for net access to be installed at the Longview school, and the students continued to participate over the school year. The camp program was repeated the following summer, and the activity was increasingly integrated with the curriculum over the next school year (Hughes and Walters 1997). Around January 1995, Phoenix College received an ARPA grant jointly with researchers at Xerox PARC, including Danny Bobrow, Vicki O'Day, and Vijay Saraswat. The virtual world was moved from the MUSE software to MOO, and renamed Pueblo. As of February 1998, 2600 people total had participated in Pueblo at one time or another. This number includes occasional visitors, and people who have ceased their participation. Roughly 1400 people were active members as of that date (O'Day 1997). Throughout its existence, Pueblo's designers have continued to cultivate an open, student-centered learning environment (O'Day, Bobrow et al. 1996).

Both MicroMUSE and MariMUSE/Pueblo see learning through science simulation as part of their mission, as well as learning through writing and programming the virtual world. For the reasons described above, I find the latter approach more promising. Both the MUSE and MOO software are unfortunately difficult to use, and this has limited what children have been able to accomplish technically. MOOSE Crossing differs from these projects in the new technology developed for the children, and in the explicit application of the samba-school metaphor to guide its design process. MOOSE Crossing includes a new programming language (MOOSE) and client interface (MacMOOSE and JavaMOOSE) designed to make it easier for children to learn to program (Bruckman 1997; Bruckman 1998). Children on MOOSE Crossing are programming new places and objects that have behaviors. In the process, they are learning creative writing and computer programming in a self-motivated, peer-supported fashion.

MOOSE Crossing has been open since October 1995, and has over 200 participants. Members can enter an annual Holiday Pet Show and Spring House and Garden Show, and the community votes for the most successful projects. Although the activity was originally designed to be used primarily from home and in after-school programs, it is increasingly being used as an in-school activity (Bruckman and De Bonte 97). Many teachers are being given net connections, but no support for how to use them. MOOSE Crossing provides a support for how to use those net connections in a constructionist rather than instructionist way.

6. Conclusion

The literature on educational use of the Internet is in its infancy. In many countries, political support for equipping schools with network connections outpaces empirical evidence for their value. The reasons for this unusual enthusiasm are primarily symbolic, political, and economic. Many people take a technological positivist view: technology is progress. Not connections are a synecdoche for all of technology and its great promise to make society better. The concept of children on the net has deep cultural resonance because it brings together two powerful symbols of hope and progress. Politicians see promising net connections to schools as a relatively uncontroversial way to win the good will of their supporters.

From an economic perspective, advocates of distance education see net connections as a possible way to reduce the cost of education. This is often openly discussed financial terms: on a Georgia Institute of Technology faculty mailing list, one senior faculty member recently expressed fear that we would "lose market share" to other schools if we didn't offer such programs. Advocates see great economies of scale in one "master teacher" being able to lecture to hundreds or thousands of students. There are grains of truth behind this argument: piping video lectures across the net may not be the ideal pedagogical approach, but something is better than nothing. With distance education, many students who previously had no access to education are getting at least some education. On the other hand, for those students who already had access to education, this distance approach represents a lowering of the quality of education available to them. If one lecturer reaches hundreds or thousands of students, then only a tiny fraction of students can actually ask questions. This is functionally equivalent to mailing them a video tape. One question we need to ask, then, is whether these economies are really necessary, or is the technology just being used as an excuse to reduce net societal investment in education. An even better question to ask is whether this technology can be used in more effective ways.

In its most simple-minded form, distance education is a "horseless carriage." People are trying to understand a new medium (cars, education on the Internet) in the terms of an old medium (horse-drawn carriages, lectures) without recognizing that the new medium has different affordances. Educational use of the Internet needn't be an impoverished, literal-minded version of traditional instruction. More innovative thinking and careful, self-critical research is required to understand how to use this new medium to best advantage.

Just because hype about education on the Internet has outpaced research on its real value does not mean that the net has no educational potential. Preliminary results are promising—the Internet may yet live up to those high expectations. This article divides approaches to educational use of the Internet into four broad categories (information delivery, information retrieval, information sharing, and technological samba schools.) It is hoped that these categories will prove useful in analyzing both the strengths and weaknesses of future research projects.

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BIO

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