# The Introduction of Computer Networking and Activities in K-12 Classrooms: A Case Study of a Secondary School

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## ABSTRACT

The purpose of this research is to document data on the implementation and integration of computer networking capabilities and activities in regular classrooms, looking specifically at the expectations and concerns of those involved (school administrators and teachers), and at the issue of integrating the networking capabilities with the regular curriculum. The outcomes of the research will be recommendations on practices that produce successful or unsuccessful implementation of network-based classroom activities. Particular attention is given to Internet-based K-12 classroom activities and to the creation of electronic communities of learners.

## RÉSUMÉ

Le but de la présente recherche est de documenter l'information sur l'implantation et l'intégration des capacités et des activités en matière de réseau d'ordinateurs dans les salles de classe régulières. Un accent particulier est mis sur les attentes et les préoccupations des personnes impliquées dans les projets (personnel d'administration et personnel enseignant) et sur l'intégration des possibilités de réseau dans les matières régulières des programmes d'enseignement. Les résultats de la recherche vont se traduire par des recommandations concernant les pratiques produisant une implantation réussie ou non des activités de réseau dans les salles de classe. La recherche

porte une attention particulière sur les activités reliées à l'internet dans les salles de classe de la maternelle jusqu'à la fin des études secondaires et sur la création d'une communauté électronique d'apprentissage.

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# INTRODUCTION

There has been growing dissatisfaction of the public with the educational system, especially with respect to providing students with the knowledge and skills they now need for higher studies and the workplace. This dissatisfaction has manifested itself through two seemingly contradictory demands: First there are calls for a "back to basics" curriculum; and second, there are calls for more classroom activities using new technologies. The introduction of new technologies, however, has not been entirely successful. Indeed, promises made decades ago concerning the introduction of computer technology remain for the most part unfulfilled.

In addition, although computer technology is present in schools, it is underutilized. This has not had the effect, however, of banishing technology from the classroom. And with the growing interconnection between K-12 local area networks and university or regional wide area networks, exhortations for new uses of old technologies along with the introduction of new technologies in classrooms are likely to occur. Of these new technologies, use of local and wide area networks (WANS) by students is currently one of the most popular.

Public dissatisfaction with the educational system has also caused a re-examination of the effectiveness of learning strategies. In the last twenty years, the popularity of new learning strategies emphasizing critical thinking and collaboration has increased. Most of these new techniques fall under the rubric of collaborative learning methodologies. Not surprisingly, there have been increased efforts to analyze and treat the problems with education from the perspective of collaborative learning, situated cognition, reciprocal teaching and authentic instruction.

These developments in turn require environments in which technology can be successfully integrated with new learning techniques while also enhancing traditional learning tasks. In these new environments, teacher endorsement and support for new technologies are thought to be essential. Interestingly enough, one of the reasons given for the failure to implement more successfully new technologies is lack of teacher participation in their planning and introduction (Plomp & Akker, 1988; Schultz & Higginbotham-Wheat, 1991).

There exists, therefore, a need for data and models of how such environments can be implemented successfully in the educational system. This study proposes to examine the process of introducing and implementing collaborative learning network-based K-12 classroom projects with special emphasis placed on Internet-based projects. Furthermore, to meet teacher demands for more participation and involvement, an approach called participatory design (Schuler & Namioka, 1993) is utilized. In addition, given the need for collaboration and acculturation to the technology by participants, this study borrows heavily from Brown's work on design experiments and learning communities (Brown, 1992, 1997).

It is argued that four distinct but related developments are responsible for bringing the following issues to the fore: Public dissatisfaction with the educational system, exhortations for the introduction of new technologies, a re-examination of learning approaches, and the need to create new environments where these developments are not studied in isolation. That is to say, while these developments may be complementary, the process of how to merge and introduce them in classrooms remains unknown.

## CHAPTER 1: THE ADVENT OF NETWORKING TECHNOLOGIES AND THE INTERNET

The impact of new networking technologies and the Internet on education is recent, spanning approximately 10 years. Indeed, the rate of development is astonishing given that national projects such as the Canadian Network for the Advancement of Research, Industry, and Education (CANARIE), the U.S. National Research and Education Network (NREN) and the succeeding National Information Infrastructure (NII) are less than a decade old (see Appendix A for a history of the Internet and national programs).

These programs created the environment fostering the introduction of networking technologies in the classroom. They encouraged the experimentation and use of these new systems in an effort to enhance traditional learning tasks. While the original intent of these new high-speed networks was military, the communicative and interactive potential of the technology was soon harnessed for educational and business purposes.

Nevertheless, early and later educational networking projects had little or no guidance concerning the process of how to maximize the technology and on how to introduce most effectively the technology to teachers and students. And although there is enthusiasm for local and national educational networks, there is concern that teachers require more effective introduction to their use and potential. Furthermore, the need for on-going support and instruction on the use and evaluation of the technology is also a present concern.

That is, the development and use of K-12 networks lacked studies on the process of how to introduce networking technologies and on how to sustain interest and knowledge in what is an ephemeral and constantly changing environment. Indeed, implementation of networks has emphasized school connections and teacher access to the technology while ignoring the process of how to introduce and integrate effectively the technology in classrooms.

# CHAPTER 2: THE ADVENT OF CANADIAN AND U.S. K-12 NETWORKS

In the United States and Canada, the advent of the Internet has engendered the development of K-12 state, regional, and provincial networks. Normally, these networks benefit from existing state research networks administered by research centers or universities; educational networks are created as sub-networks in the existing telecommunication infrastructure. In this manner, the K-12 sector is able to offer its community access to Internet services and resources (Clement, 1992a, 1992b). Moreover, connections to state or regional networks offered the K- 12 sector gateways to the U.S. and Canadian components of the world wide Internet as well as access to most countries in the world.

Canadian student and teacher access to the Internet has been uneven; some regions have established educational networks while other regions, particularly remote regions, offer teachers limited or no access. Arguably, there is concern that some teachers and students are deprived of network-based activities, especially since research has consistently shown that these activities may offer substantial benefits (Cohen & Riel, 1989; Hunter, 1992; Silva & Breuleux, 1994). Nevertheless, regions which have not fully established K-12 networks are faced with the unique opportunity of profiting from existing K-12 network technical and administrative models, both Canadian and American.

Of existing network models, those that are subnetworks or linked networks to existing academic networks appear to be the most popular.

The move away from first generation technology (terminal to host systems) to second generation (WWW based systems) technology has been slow in Canadian schools. This is important to note because the method in which schools access the Internet "can have a considerable effect on the extent that potential instructional benefits are actually realized" (Bull, Sigmon, Cothern, & Stout, 1994, p. 230). In terminal to host systems, all of the processing of data is done by the host computer (Newman, Bernstein, & Reese, 1992). Furthermore, users are restricted to command-line interfaces and, to effectively navigate the Internet, must learn a myriad of different commands and procedures. Still, because almost any hardware configuration can use terminal to host connections, this model remains a viable option for technologically underprivileged schools.

More technologically privileged schools have access to second generation technology based on graphical user interface (GUI) software and hypertext transfer protocol. As a result, these privileged schools may experience a qualitative shift in the way the Internet is used by teachers and students. Usually, Internet access via GUIs is based on client/server technology where the processing of data is distributed: The client computer (or the user's computer) sends a request to the server who is responsible for the indexing, sorting, and searching of the shared files. While the server is processing the information, the client can process its own applications, making for a far greater use of computing resources.

Schools in this category use mostly Serial Line Internet Protocol (SLIP) or Point to Point Protocol (PPP) with GUIs. Other schools are able to benefit from direct connections through a router or a bridge. This model, therefore, allows for the full use of the desktop computer's intelligence and flexibility and of new software such as World Wide Web browsers.

Of interest, however, is the need for more research concerning the design and presentation of GUI interfaces for second generation technology. That is, it is assumed that students experience a qualitative shift in the use of networks when they are able to progress from first generation to second generation technology. World Wide Web servers, hypertext and hypermedia are believed to offer more optimal learning environments. For example, Aust claims that the "easiest information retrieval method to learn is hypertext browsing. When browsing hypertext, the user simply clicks a highlighted word or phrase to link to new information" (1994, p. 256).

Yet, unlike traditional libraries where information is organized by experts according to well established rules and conventions, the Internet offers little organization. And, the tools for browsing cyberspace, whether first or second generation, are designed by persons with "limited training in information organization" (Aust, 1994, p. 257).

The third generation, based on intelligent agent technology (also referred to as Knowbots), is under development and research. An intelligent agent is any program or system that acts on a user's (or another agent's) behalf to accomplish goals or tasks. This includes everything from simple search engines to complex autonomous processes. In the near future, intelligent agents will roam the network for the user searching, locating, and retrieving information even when the user is not connected to the network (Marina & Hawkins, 1994; Markoff, J., 1994). The software Harvest, which provides an integrated set of tools to retrieve, disseminate, locate, and organize information across the Internet is indicative of this trend (Bowman, et al., 1994). The Internet Research Task Force, Research Group on Resource Discovery has been experimenting with Harvest for approximately 18 months.

Some see the development of intelligent agents as facilitating the integration of telecommunication technologies in schools. For example, a frequent demand by pressure groups on policy makers implementing the U.S. National Information Infrastructure is that it be easy to use (National Coordinating

Committee on Technology in Education and Training, 1994). That is, "... many educators continue to experience considerable anxiety around computers and other electronic devices. An information and electronic service resource driven by friendly "electronic agents" would help to overcome this significant problem" (1994).

## 2.1. The Development of K-12 Networks: Issues

Santoro's definition of computer-mediated communication (CMC) is used when discussing educational uses of networking because his definition is directly related to how this study is conducted in regards to the issues discussed in page 10. Santoro defines CMC as "computer applications for direct human-to-human communication. This narrow definition includes electronic mail, group conferencing systems, and interactive 'chat' systems. At its broadest meaning, CMC can encompass virtually all computer uses" (1995, p. 11). The meaning of educational networking as used in this work, spans these two definitions.

The development of K-12 networks providing Internet access has closely paralleled the growth of the Internet, particularly in the United States. Many American states offer K-12 teachers and students access to a myriad of Internet resources and services through dedicated K-12 networks. Furthermore, access to network resources usually is not restricted for administrative purposes; many networks are making efforts to link teachers and students, Texas TENET being a case in point (Stout, 1992). Indeed, the user group experiencing the largest increase in accounts to the TENET network are classroom teachers, although the majority of TENET users still are administrators, coordinators, and librarians. It is thought that the number of users will reach exponential proportions once classroom accounts are instituted (WEB Associates, 1993, p. 14).

Another sign of the growth of K-12 networks is the large and ever growing number of existing Internet classroom projects. While the great majority of projects are simply designed around the use of electronic mail, others have utilized more complex Internet resources. World Wide Web (WWW) projects, for instance, where kids create WWW servers and post documentation, have been implemented at many schools. Furthermore, many of these projects are undertaken in conjunction with local universities.

One example is the University of Minnesota College of Education's Web66 (http://web66.coled.umn.edu/) that plans to help K-12 educators learn how to create their own WWW servers (Collins, 1994; Collins, personal communication, 1994). Another is the SchoolWeb Exploration Project (http://www.scu.edu.au/sponsored/ausweb/ausweb95/papers/education2/mason/school_web_exploration.html), an international coalition of universities and organizations that tries to help elementary and secondary schools incorporate use of the WWW in their curriculum. In Canada and Quebec, an early project was Ados Branchés, which attempted to use **WWW** technology to improve the scope of francophone communication and understanding of culture for young children (Breuleux & Silva, 1996, June). Lastly, there is growing recognition on the part of educators that Internet-based classroom projects can have a positive effect on learning and instruction (Silva & Breuleux, 1994), although more data to confirm this claim is needed.

In Canada, the push to establish K-12 networks has lagged behind American efforts. School links to the Internet are uncommon and depend primarily on first generation terminal to host connections. Moreover, Canadian schools pay business rates for telephone lines further limiting access. This situation parallels that found in the United States where almost 90% of K-12 classrooms lack basic access to telephone service. And, similar to Canada, most U.S. schools are charged at the corporate rate (Princenton Survey Research Associates, 1993 cited in National Coordinating Committee on Technology in Education and Training, 1994).

In the United States, however, with the passage of the *Telecommunications Act of 1996* (http://mayet.som.yale.edu/~sim/telecom/TelecomActof1996.htm) schools and libraries can benefit from discounted telecommunications services. Indeed, a key provision of the Act (section 254) reads: "Access to advanced telecommunications services for schools, health care and libraries: Elementary and secondary schools and classrooms, health care providers and libraries should have access to advanced telecommunications services as described in section (h)" (United States, Congress, Telecommunication Act of 1996, 1996, http://mayet.som.yale.edu/~sim/telecom/TelecomActof1996.htm).

And access to telecommunications services is guaranteed by an additional section of the Act: "All telecommunications carriers serving a geographic area shall, upon a bona fide request for any of its services that are within the definition of universal service under subsection (c)(3), provide such services to elementary schools, secondary schools, and libraries for educational purposes at rates less than the amounts charged for similar services to other parties. The discount shall be an amount that the Commission, with respect to interstate services, and the States, with respect to intrastate services, determine is appropriate and necessary to ensure affordable access to and use of such services by such entities" (United States, Congress, Telecommunication Act of 1996, 1996, http://mayet.som.yale.edu/~sim/telecom/TelecomActof1996.htm).

The discount took effect on January 1, 1998. Discounts range anywhere from 20% to 90% of costs, depending on the level of economic need. Discounts will be slightly higher for rural schools. Not more than $1 billion dollars were made available for the initial period between January 1, 1998 to June 1, 1998. A total of $2.5 billion will be available on an annual basis in support of the program. It is estimated that almost 70% of all U.S. schools will receive at least a 50% discount on many telecommunications services.

On May 7, 1997, the U.S. Federal Communications Commission voted unanimously to implement discounted telecommunications services to schools and libraries as part of their decision on universal service: "We adopt the Joint Board's recommendation that all eligible schools and libraries (1087) should receive discounts of between 20 percent and 90 percent on all telecommunications services, Internet access, and internal connections provided by telecommunications carriers, subject to a $2.25 billion annual cap" (United States, Federal Communications Commission, 1997, http://www.fcc.gov/ccb/universal_service/fcc97157/sec10.html). The various challenges to the *Telecommunications Act of 1996* were thus denied. The Act, along with the U.S. Federal Communications Commission's decision, will address one of the primary obstacles schools face when attempting to implement Internet projects.

Still, the situation at the present time is that, for regulatory purposes, American and Canadian educational institutions are classed in the same category as business customers, even though their needs are far different from most businesses. Or, as put by the National Coordinating Committee on Technology in Education and Training, "Schools have not been the beneficiaries of the universal service policies that resulted in the delivery of basic service at affordable rates for most American homes" (1994). Indeed, higher telephone rates are perhaps the primary obstacle to more extensive and effective use of networking and telecommunication technologies in Canadian (Telecommunications Committee, Canadian Educational Network Coalition, 1994) and in American (Bull, Sigmon, Cothern, & Stout, 1994, p. 233) schools using dial-up connections. After all, school teachers are probably the only white collar professionals lacking adequate access to telephones.

Still, better rates for schools are but a short term solution. As the popularity of Internet use in classroom grows, it is unrealistic to expect schools to acquire telephone lines to meet the demand, especially when demands for Internet and network connectivity are growing at a rapid pace. For instance, by 1995 half of all American schools had some form of Internet connectivity (United States, President's Committee of Advisors on Science and and Technology, Panel on Educational Technology, 1997, http://www.whitehouse.gov/wh/eop/ostp/nstc/pcast/k-12ed.html).) That figure increased by almost 25% in 1997 (United States, National Center for Education Statistics, 1998, p. 1).

Although the price of high-speed modems has dropped significantly, it is still an insignificant amount compared to the price of telephone lines. Local area network connections to WANS is arguably the long term solution for schools.

Lastly, Canada, unlike the United States, has few organized pressure groups concerned with education and networking. The Consortium for School Networking (CoSN), for instance, is the American national voice for advocating access to the emerging National Information Infrastructure (NII) in K-12 schools. CoSN has been effective in lobbying for:

Equal access, equity and quality of school networking;

Developing and disseminating networked-based information resources;

Connecting you with other leaders on the cutting edge of classroom networking;

The utilization of telecommunications to support instruction.

The Canadian Educational Network Coalition (CENC, at one time the most effective Canadian educational networking lobbying group, had a working relationship with Canada's telecommunication carriers: Stentor (an alliance of the nine major Canadian telephone companies), and Canada's telecommunication infrastructure, CA*Net and the Canadian Network for the Advancement of Research, Industry and Education (CANARIE). For example, the CENC received support from Stentor, CA*Net, and CANARIE during its writing of a brief to the Canadian Radio and Telecommunications Commission that asked for changes to the Canadian Telecommunications Act, 1993 so that more effective customized telecommunication services could be offered to K-12 schools.

The CENC, however, lacked CoSN's funding and organizational structure. Indeed, it rested on a loose association of interested individuals lacking formal representation. Another problem is that there are few other effective lobbying groups in Canada concerned with technology and education. CoSN, in contrast, works closely with other groups such as CAUSE and EDUCOM who, although concerned with educational technology in higher education, share many of the same objectives.

## 2.2. K-12 Networking Models

### 2.3. United States

The interconnection of schools to each other and the Internet is explicitly stated in U.S. plans to upgrade and develop the former NSFNet. For example, in 1994 Vice President Gore announced the Administration's intent to connect every classroom in the United States to the Internet. Libraries, hospitals and clinics were likewise targeted for Internet access. Or, as stated by Vice President Gore, "we must do this to realize the full potential of information to educate, to save lives, provide access to health care and lower medical costs" (cited in Gonzalez, 1995)

The effect of these initiatives has been to promote the implementation of new K-12 networks. It likewise aims to upgrade existing networks giving schools access to second generation client/server network technology. Indeed, the number of teachers and school children benefiting from network-based resources and services is growing at a phenomenal rate. Furthermore the growth of these networks is promoting greater teacher and student interaction and collaboration with sectors from which they were previously excluded, namely universities, research centers, and businesses. Below are examples of early U.S. K-12 networks that exemplify efforts to meet the above objectives.

### 2.3.1. Examples of Early Developments in U.S. K-12 Networks

Conceived in 1977, The Florida Information Resource Network (FIRN) (http://www.firn.edu/) has the fundamental goal of providing Florida's educational community with access to telecommunication technology that serves public education. At this writing, FIRN interconnects Florida universities, community colleges, and school districts with a network that serves as the Florida Department of Education primary data communications facility (Florida Department of Education, 1992). Whether intentionally or not, FIRN has been able to meet one of the primary objectives of the NII: The development of new electronic communities to promote the sharing of knowledge and expertise.

Schools linked to FIRN also had gateways to a number of other networks including the TYMNET, Bitnet, the IBM Information Network, SURANet (Southeastern Universities Research Association Network), and most important of all, the Internet via the former NSFNet. Today, FIRN is interconnected to the WWW. Administrators of FIRN view interconnections to other networks as being critical to the evolution and objectives of FIRN. They believe that although FIRN should strive to offer the K-12 community access to more resources, in stand-alone mode, FIRN cannot meet all the needs required for adequate K-12 classroom support. However, a wealth of resources are readily available via the Internet elsewhere. FIRN will provide networking services so as access to these remote materials are possible by Florida teachers and students (Florida Department of Education, 1992).

Some of the resources offered by FIRN include: Electronic mail (6,000+ registered educators as of December 1992), group conferencing, library resources, the CNN "Classroom Guide, and many other services. However, FIRN has also offered exceptional support to educators interested in implementing network-based classroom projects. Some of these projects include: KIDS-91, an international grassroots project that gives children the opportunity to become involved in a global dialogue; a communications project where elementary school children can share information, dialogue with others, and practice interviewing with out-of-state school children; and the Telecommunications Opportunities for Gifted Learners, where gifted children are able to query and interview experts using real-time telecommunications (Ambler, Jacobs, Potter & Davis, 1991).

NYSERNet (New York State Education and Research Network) (http://www.nysernet.org/) is a statewide network that interconnects over 600 New York State research centers, universities, K-12 schools and public libraries to the Internet. Other members include hospitals, museums, small and large businesses, and Indian nations. NYSERNet is a pioneer among K-12 networks: It was the first regional network of the NSFnet, it was the first regional network to offer T1 connectivity, and it was the first regional network with a T3 backbone (NYSERNet, 1994). Sponsors include IBM, the New York State Science and Technology Foundation, and the NSF. Similar to FIRN, K-12 and university collaboration is promoted by the structure and mandate of NYSERNet.

Its mandate is to foster network access to the research and education community, make computational resources and new technologies available to its user population, and create an information access structure that offers equitable access to New

York state residents. So as to ensure greater widespread use of the network, NYSERnet is a not-for-profit corporation (Linda Carl, NYSERnet, Marketing and Member Services, personal electronic communication, Nov. 8, 1993). Again, within the context of the NII, NYSERNet claims that its facilities improved: Education at all levels (K-12 to university), research and development, economic development and competitiveness, transmission of health care related information, and community communication and public information (NYSERNet, 1994).

NYSERNet's Empire Internet Schoolhouse project and Special Collections: Higher Education are other examples of innovate uses that educators can make of the Internet. Essentially, the Empire Internet Schoolhouse offers educators access to projects and resources available on the Internet. Some categories of resources include: The Assembly Hall, where users are able to create or join discussion groups; the Library and Internet Reference Tools, where access to databases, library catalogues, etc., is made possible; a Career and Guidance Center for high school students; and lastly, a School Reform and Technology Planning Center for educators who need information on those topics. The Higher Education category offers users a myriad of university level information, expertise, and resources.

Another network exemplifying the above trends is SENDIT (http://sendit.nodak.edu/). Developed by the North Dakota State

University School of Education and Computing Center, the express purpose of SENDIT is to give North Dakota K-12 educators and students access to electronic resources. Sponsored in part by the Educational Telecommunications Council (ETC), as of December 31, 1992 its clientele included 769 teachers, 1521 students, 84 administrators, and 120 other users. Access to the Internet is facilitated through a link to the North Dakota Education Computer Network.

Some interesting projects include the Electronic Classroom, which gives classroom students access to CNN and Newsweek's Newsroom guide. Students and teachers also have a gateway to the worldwide K12Net, where they are able to join and participate in discussion groups. An example of the ability of networks to create situated learning environments, is the SENDIT classroom project Campaign '92. Students, through the use of telecommunications, were able to access legislative bills, candidate speeches, and press releases, in an effort to understand the political process.

Lastly, the NSF, in an effort to foster more collaboration between K-12 schools and postsecondary institutions, made access to the Internet by state postsecondary institutions contingent on their agreement to support K-12 research and education projects. K-12 educators, therefore, now have access to a world of expertise and research support. Once again, Clement's (1992a, 1992b, 1992c) argument that research centers and universities can play a significant role in network based projects is supported. Moreover, with this networking structure, SENDIT reflects the trend of U.S. networks to create greater K-12 and university collaboration.

TENET (The Texas Education Network)(http://www.tenet.edu/) is perhaps one of the most successful statewide K-12 networks. It was created with the idea that a communications infrastructure had to be established to overcome the obstacles preventing use of interconnected networks for education and educational research. Similar to NYSERNet, SENDIT, and FIRN, TENET utilizes the postsecondary telecommunications infrastructure. And it uses the regional network, the Texas Higher Education Network (THEnet), for Internet access and use. Naturally, this in turn has fostered a variety of K-12 and university collaborative projects.

TENET offers full Internet connectivity and resources. By August 1992, TENET had a clientele of over 18,000 registered users, of which 80% are K-12 educators (WEB Associates, 1993, p. 14), making over 85,000 logins a month. Moreover, each month, one thousand new users apply for accounts. When teachers are able to add classroom accounts to their own, growth is expected to reach exponential proportions. Even more important are the efforts of TENET administrators to shift use of the network from first generation technology to full second generation interactivity. By fall 1997, Texan elementary and high schools could claim a significant presence on the WWW (http://www.tenet.edu/education/states/texas.html).

That is, the Texas Department of Education is attempting to interconnect schools through a project that will support local area network to wide area network connections. This will eliminate the problem of dial-in, terminal to host connections, significantly increase the data transfer rate to 56 kbps and allow for the use of GUIs and client-server software (Bull, Sigmon, Cothern, Stout, 1994, p.237). Naturally, more optimal use of the Internet will become possible.

Teachers, in support of integrating use of the network with curricular activities, cited the following as justification for developing TENET-based projects: Simulations to foster critical thinking, opportunities for practice (especially writing), and perhaps most important of all, opportunities for collaborative problem solving (David, 1993, p. 22). Other benefits included timely access to news about world events, access to databases and library catalogues, and the ability to retrieve and share instructional materials.

## 2.4. Canada

Similar to the U.S., Canadian projects to develop high-speed networks have included K-12 schools as part of their potential user population (Harasim, Hiltz, Teles, & Turoff, 1995). Until very recently, however, the connection of Canadian schools to wide area networks has not been a priority and has lagged behind U.S. efforts. Nevertheless, there exist provincial and federal initiatives that, given the budgetary and support constraints, have been notably successful. Of these projects, New Brunswick's efforts to interconnect its K-12 public schools, Newfoundland's STEM~Net, Ontario's Education Network of Ontario and the federal government's SchoolNet merit discussion.

2.4.1. New Brunswick

New Brunswick is especially active in efforts to introduce telecommunication technology in schools. For example, New Brunswick's Task Force on the Electronic Highway has recommended that, through the Excellence in Education initiative, its schools be linked to wide area networks and the Internet by 1996 (New Brunswick Task Force on the Electronic Information Highway, 1994, p. 14). Presently, schools are being connected for full Internet access. Parallel to network access are New Brunswick's initiatives to increase student computer literacy.

New Brunswick's government passed legislation requiring high school graduates to possess computer skills as a prerequisite for graduation. In the 1995-1996 school year, grade 7 and 8 students will be required to take 27 hours of computer training. At the college and university level, students must complete 15 hours of mandatory computer learning. And according to Margaret Smith, spokesperson for the New Brunswick Department of Education, it will be during elementary school years that children will be first introduced to computer skills.

New Brunswick is able to implement educational telecommunication initiatives because it benefits from the most advanced telecommunication infrastructure in the country. So as to exploit optimally the existing telecommunication infrastructure, McKenna named George Corriveau as Canada's first Minister of State for the Information Highway. His mandate is to examine ways to make New Brunswick an international leader in electronic communication networks. New Brunswick also profits from the fact that its telephone company, NBTel, has the only fully digital Canadian phone system. Use of fibre optic cable allows for easier introduction of new technologies like the World Wide Web and video-conferencing.

### 2.4.2. Newfoundland's STEM~Net

STEM~Net (http://www.stemnet.nf.ca) is a provincial wide area computer network serving Newfoundland and Labrador, the objective being to "provide support and services for K-12 and rural public college educators in the areas of curriculum instruction and professional development" (STEM~Net, 1994, p. 1). Its mandate is restricted to active educators in public schools, rural-college educators, Memorial University education faculty, and selected distance-education programs. Of particular interest, and similar to Sendit, is Stem~Net's goal of improving communications among K-12, college and university educators (STEM~Net, 1994). Clement's (1992a, 1992b, 1992c) view that networks offer potential for better K-12 and academic collaboration and partnership is given further support.

Users on Stem~Net have access to all Internet services including e-mail, gopher, reader news, WWW browsers and servers, ftp, and telnet. Access to the Stem~Net computer is made by direct dial-in or through connections that have installed NLnet nodes. NLnet is a consortium composed of Stem~Net, Memorial University, Colleges and some government institutions. Those that must make direct calls to Stem~Net do not incur long-distance charges.

Stem~Net presents an interesting case study for several reasons. First, it demonstrates the potential arising out of K-12, academic, and government cooperation; Stem~Net would have had great difficulty interconnecting Newfoundland schools without access to academic and government networking resources. Second, Stem~Net has made great effort to connect remote schools, allowing teachers in Labrador and other areas to participate in the development of new networking curriculum and skills. Third, it demonstrated the innovative use of old and new technologies. For instance, Stem~Net has created a portable ethernet training network which allows teachers to experiment with new applications like the World Wide Web client, Netscape. And last, along with New Brunswick, Newfoundland educators realize the benefits for students and teachers arising from access to electronic resources and services.

2.4.3. Ontario

The Education Network of Ontario (ENO) (http://www.enoreo.on.ca/) is a recent project created for use by the Ontario K-12 community: Teachers, administrators, trustees and government. It began in 1993 as part of the Ontario Teachers Federation project, Creating a Culture of Change. The goals were to: diminish the isolation of teachers in schools and improve their access to information and human resources in a time of budgetary constraints.

In November 1995, the number of active users reached 36,462 (Education Network of Ontario, 1995). Indeed, anyone who works in an elementary or secondary education is eligible to register with the ENO and receive an account on the network. In merely 16 months of existence, ENO registered nearly 10% of Ontario teachers.

Basically, ENO allows teachers to communicate with others who share similar interests and concerns. Teachers have access to conferencing systems, electronic mail and the Internet. There are approximately 75 active conferences on ENO. Of interest is that the moderators are teachers who, because of their work, receive time-release and/or an honorarium (Education Network of Ontario, 1995).

Furthermore, ENO offers basic instruction in use of telecommunication technology and specialized workshops on sophisticated uses of the technology. Similar to Stem~Net, a training the trainers approach is utilized. Trainers are responsible for introducing the technology to their local school boards and schools. They must also conduct training workshops at the schools' or school boards' requests (Educational Network of Ontario, 1995).

2.4.4. Canada's SchoolNet

SchoolNet (http://www.schoolnet.ca) is a collaborative project sponsored by the Canadian federal government, business and educational communities. In 1993, the government committed approximately C$1.6 million to link 300 schools. Additional funds were donated by Canada's fullservice telephone companies. Other sponsors include Industry and Science Canada, provincial/territorial ministries of education, and businesses. Perhaps of critical importance was the initial participation and support of Canadian companies involved in information and telecommunication technology research: CA*net Networking Inc., CANARIE Inc., Apple Canada, and Quebec's provincial academic and research network, le Réseau interordinateurs scientifique québécois.

Simply put, SchoolNet's primary objective is to equip Canadian schools with the capability to connect to regional, national, and international networks. The above objective aims to support student access to online information, offer educators the resources needed to improve classroom instruction and school curricula, and promote greater communication among local, provincial, and federal administrative educational agencies. During its start-up year, SchoolNet interconnected hundreds of schools that had the requisite telecommunication technology to link to the network. As of June 1994, approximately 3,200 Canadian schools have used SchoolNet resources (Canada, Information Highway Advisory Council, 1994, p. 4). Schools will access SchoolNet resources through the Internet, courtesy of CA*net.

An innovate service available on SchoolNet is the Electronic Innovators Program (EIP) where students and teachers are able to communicate with experts and professionals from government, universities, and industry from around the world. Projects established with support of SchoolNet, therefore, have unparalleled access to worldwide expertise. There are currently over 400 participating Electronic Innovators from countries such as Russia, Singapore, and Germany. The implicit purpose of EIP is to create teleapprentices so as to contextualize and give meaning to the activity and learning.

Similar to NYSERNet, SchoolNet used a gopher to facilitate search and retrieval of materials. Gophers in both English and French are still available. Even though gophers offer an intuitive and user-friendly interface allowing novice users to navigate the network with minimum instruction, a SchoolNet access and training manual assisted teachers in making the most use of available electronic resources. Information on using e-mail, networking protocols, and electronic discussion groups, was readily available.

Two SchoolNet World Wide Web (WWW) Servers, English and French, are also operational (http://www.schoolnet.ca or the French version at http://www.rescol.ca). The benefits of a WWW server lies in its ability to incorporate graphics and sound. In addition, the problem of diacritics is eliminated; French accents are displayed without requiring special emulation. Naturally, this is of special concern to Quebec educators.

Some resources accessible via the SchoolNet gopher and WWW server include electronic discussion groups, school advisors to help teachers in matters of curriculum development and project support, electronic newsfeeds from the Globe and Mail Classroom Edition and Southam News, government information, electronic libraries and databases, and links to national and international electronic educational networks. Similar to FIRN, SchoolNet recognizes the potential for resource sharing among other networks devoted to K- 12 education and research.

Interestingly, SchoolNet emphasizes the opportunity for Canadian classrooms to participate in collaborative projects with other schools or with students in foreign countries: SchoolNet facilitates this process by having students from different regions or countries work in collaborative teams to solve problems, conduct experiments, share expertise, etc. Indeed, the possibility of participating in groupwork locally or remotely is understood as a major benefit of the SchoolNet project and meets many of the Federal objectives concerning educational networking.

2.4.5. Quebec

Educational telecommunication projects and initiatives have been undertaken by Quebec K-12 schools during the last few years. A brief review of the Direction des ressources didactiques du ministère de l'Éducation du Québec home page (http://www.eduq.risq.net/DRD/) will point to many new projects. Many of these projects are based on electronic mail, and so cannot profit from many of the benefits of real-time communication. Others, however, experienced exceptional success, the Village Prologue project (http://www.eduq.risq.net/DRD/P_telem/Village.html) being a case in point (Quebec-Alberta Telecomputing Project, 1993). In addition, while the number of Quebec schools participating in electronic networking projects was probably greater than 41, the number is low when compared against other North American regions, particularly the United States.

More worrisome is that to the authors' knowledge, few Quebec schools have local area networks connected to the Internet. In fact, some Quebec schools have serious constraints on their use of first generation Internet technology due to the lack access of phone lines in the classroom or school. Still, even though the Provincial government has not rapidly began to interconnect all Quebec schools, either through dial-in or through local area networks, education policy makers and educators are becoming increasingly aware of Quebec's K-12 networking needs.

Some positive developments under review are the possibility of linking more students and teachers via a provincial educational network called EDUPAC and the creation of a workgroup, le Groupe de travail en télématique scolaire of the Ministre de l'Éducation du Québec, to examine K-12 networking issues. Regrettably, there has been little discussion concerning potential collaboration between the academic and K-12 sector arising out of these possible electronic interconnections.

This is an issue of concern, given the need for Quebec faculties of education to undertake more applied research in schools. Furthermore, networks may engender greater research collaboration between teacher and researcher, and offer a change in the role of the teacher from research subject to research partner. Lastly, one of the more common complaints voiced by teachers with access to networks is the lack of instructional Internet support, a resource widely available in universities.

Indeed, teachers are well aware of the need for instructional support. For example, in a survey by Honey and Henriquez on network use in technology privileged schools it was found that use of telecommunication for administrative or educational purposes, was self-taught (Honey & Henriquez, 1993, p.8, 12). Even more disturbing is the finding that in 1993 only 20% of teachers were familiar with the Internet and only 4% had access to it (Princeton Survey Research Associates 1993 cited in National Coordinating Committee on Technology in Education and Training, 1994).

A more recent survey conducted on behalf of the Canadian Teachers' Federation found that approximately 50% of Canadian teachers reported no experience with educational networking technology (MacLeod, 1995, p. 12). However, the situation is not entirely bleak since 24% reported occasional use of networking technology, 7% reported frequent use of networking technology and 18% reported regular use of networking technology (p. 12).

In fact, use of telecommunications was driven more by personal interest than by a structured district wide plan (Honey & Henriquez,1993, p. 12). Perhaps this is why over 33% of teachers surveyed did not know if they had access to the Internet. Or, as Honey and Henriquez claim: "The survey results strongly suggest that support for telecommunications activities at the school and district level is virtually nonexistent" (1993, p. 12).

Fowler (1992) and Fowler and Wheeler (1995) in part support these findings. Fowler, conducted interviews of K-12 teachers using telecommunications in the classroom. She reports that teachers struggled with the technology and experienced difficulties with both hardware and software. Approximately half of the teachers said that they had considerable difficulties with the technical aspects of telecommunications (Fowler & Wheeler, 1995, p. 88).

The Canadian Teachers' Federation (MacLeod, 1995) lends further support to the above. One of the main recommendations in the report states that "SchoolNet should offer teachers connections that will make access to the outside world as simple as possible, especially considering the lack of experience most teachers have in networking" (MacLeod, 1995, p. 17). The report also states that the provision for teacher development should be an integral part of SchoolNet services (p. 18).

Awareness of the need for training and support, however, has grown. The National Coordinating Committee on Technology and Education and Training, in their document on the National

Information Infrastructure, argues that "Staff development, training, and follow up assistance is a prerequisite for effective and sustained applications of technology and telecommunications. Teacher training must not only be provided for equipment and software operation, but also for teaching strategies that incorporate the use of a variety of technologies" (1994). Arguably, teacher instruction and support offers faculties of education a unique opportunity for involvement and research.

A project designed to meet the needs of teachers for in-house training is the Group Exploring the National Information Infrastructure (GENII) project (Duckett, Townsend, Moore & Wallet, 1995). Because of its emphasis on telecommunciations, it may offer a feasible model for Quebec or other regions where in-house training is difficult to implement.

GENII attempts to "facilitate the training of classroom teachers in skills that are necessary to use the latest digital communications protocols" (Duckett, Townsend, Moore & Wallet, 1995). Of interest is the collaborative approach of GENII: It is a consortium of volunteers familiar with network protocols and technology. They include educators from Teacher Trainers programs, K-12 teachers and parents with knowledge of the technology.

Furthermore, GENII is creating a virtual faculty where teachers may turn for advice and guidance. This group attempts to offer jargon free explanations to teachers in an effort to help them incorporate Internet applications in the curriculum. Once teachers become acquainted with the technology they in turn can join the project and help other teachers increasing the effectiveness and significance of the project.

So serious is the situation teachers face concerning the lack of adequate computer training and support, that one of the main recommendations in the U.S President's Committee of Advisors on Science and Technology, Panel on Educational Technology report was that "At least 30 percent of all federal expenditures for educational technology should be allocated to professional development and to ongoing mentoring and consultative support for teachers" (United States, President's Committee of Advisors on Science and and Technology, Panel on Educational Technology, 1997, http://www.whitehouse.gov/wh/eop/ostp/nstc/pcast/k-12ed.html). Indeed, the Committee goes on to state that "Schools and school districts should be encouraged to provide time for teachers to familiarize themselves with available software and content, to incorporate technology into their lesson plans, and to discuss technology use with other teachers" (United States, President's Committee of Advisors on Science and Technology, Panel on Educational Technology, 1997, http://www.whitehouse.gov/wh/eop/ostp/nstc/pcast/k-12ed.html).

2.4.5.1. EDUPAC.

Quebec school boards have access to a telecommunication network called EDUPAC that interconnects approximately 1,100 municipalities. EDUPAC is administered by La Société GRICS (Gestion du réseau informatique des commissions scolaires), a private, non-profit corporation owned by the Federation des commissions scolaires du Quebec. Its stated mandate is to meet the administrative computing and telecommunication needs of the educational sector in Quebec (GRICS, 1993).

Until very recently, EDUPAC did not offer Internet connectivity. The Groupe de travail en télématique scolaire in conjunction with the GRICS, however, implemented a new service offering school boards Internet connectivity via EDUPAC (GRICS, 1994, p. 11). Indeed, the Groupe has made Internet access an explicit goal. Nevertheless, use of EDUPAC is made almost exclusively by school boards. And although school boards can offer individual schools access to EDUPAC, many schools remain without adequate connections. Furthermore, EDUPAC, unlike Stem~Net, is disengaged from the academic networking administrative and support infrastructure. That is, EDUPAC is not an integral component of the academic network infrastructure.

Naturally, this may dampen potential collaborative projects and resource sharing between the K-12 and academic sectors.

By 1995, 85 out of 158 Quebec school boards were connected to an outgrowth of EDUPAC, the Réseau de télématique scolaire québécois (RTSQ) (http://www.eduq.risq.net/DRD/RTSQ/RTSQ des.html). Essentially, the RTSQ is a network of smaller networks, acting as an electronic mail or electronic bulletin board for Quebec educators and students. Users number approximately 30,000.

At the present, things are improving in Quebec. Bell and other telecommunication companies are examining ways to offer schools more competitive rates for telephone lines. Videotron is attempting to do the same. For example, Videotron promised to invest $3 million to adapt the Internet for school use, while Bell Canada promised to participate in developing educational content. Also, additional funding, in a time of severe budgetary constraints, has become available for new computers. In the summer of 1996, Quebec Education Minister, Pauline Marois, announced that Quebec would invest $318 million over the next five years to upgrade computers and promote their use in public schools.

Most of the money - $207.5 million - is to be used to equip elementary and high schools with new or better hardware so as to reach a ratio of one computer for every 10 students. In 1996, there was a ration of one computer for every 21 students in Quebec's public schools. Regrettably, most of the hardware was obsolete. The new plan calls for the Quebec Government to purchase 100,000 new computers over five years. Also announced was a special fund of approximately $400,000 a year for software and multi-media special projects. Finally, Ms Marois also promised that all Quebec schools would have an Internet connection by the end of 1997.

Teacher training, however, was not given the needed attention or priority. An existing fund of $160 per teacher for training would be used to help teachers upgrade their computer skills. However, to date, a province wide training course emphasizing computer and network skills is not available. This should be noted with concern, especially since computer skills are becoming dependent on using networking technologies for collaborative work and study.

2.4.5.2. McGill University Systems, Inc.

Growing awareness of educational telecommunication caused many Quebec schools to seek Internet access outside of the educational system. The McGill University Systems Inc., a private company wholly owned by McGill University, offered selected schools in the Montreal urban area access to SchoolNet resources for approximately four years. Charges were not incurred by the schools and were assumed by McGill University

Systems, Inc. Up to the end of August 1996 approximately 70 schools benefited from free Internet connections. Access to Internet resources, however, was restricted to those available through SchoolNet.

McGill University Systems, Inc. offered free access to SchoolNet so as to understand better K-12 networking problems and needs, especially since most of its user pool is limited to universities. Because of the company's interest in educational software applications, use of its MUSIC computer operating system by schools was viewed as a unique opportunity to gain insight into the particular needs of the K-12 sector. Telecommunication software and Internet access codes were distributed to teachers for administrative or classroom use.

Connections were made using direct dial-in to the McGill University Systems Inc's main computer. Indeed, all schools used terminal to host connections. There were plans to eventually offer schools access to the company's terminal server so as to use applications such as Netscape. In addition, an easy to use bilingual interface was created to help teachers and students access SchoolNet, selected reader news groups, and electronic mail. The McGill University Systems Inc. worked closely with SchoolNet administrators in an effort to more adequately introduce SchoolNet resources to Quebec schools.

Of particular interest was the cooperation among participating schools, the McGill University Systems Inc., and McGill's Faculty of Education to initiate Internet-based classroom projects. The Department of Educational and Counselling Psychology participated in the introduction of SchoolNet to teachers and parents because of the research interests of faculty and graduate students. While the McGill University Systems Inc. offered technical and software support (teachers could call an analyst to help with technical problems), the Faculty of Education gave introductory and hands-on networking seminars to schools and school boards.

The benefits were many: The McGill University Systems Inc. gained knowledge concerning K-12 software and hardware needs. The Faculty of Education gained access to data which could be used in support of much needed educational and curriculum networking projects. And schools acquired networking expertise that is not easily available. Clement's (1992a, 1992b, 1992c) belief that universities and schools mutually profit from increased collaboration is lent further support. On August 1997, the McGill University Systems Inc., ceased its program of K-12 interconnectivity. It was felt that sufficient progress was being made by the province to interconnect schools making McGill's contribution no longer necessary.

## 2.5. Models for Quebec

Arguably, the K-12 networking model offered by GRICS is feasible and practical. To ignore an existing telecommunication infrastructure would be folly, particularly given GRICS experience in K-12 problems and needs. Furthermore, EDUPAC can provide access to Internet resources and services while offering schools access to technological support as needed. Lastly, EDUPAC, being tightly integrated with the educational sector in Quebec, may benefit from Provincial funding and support. K-12 networking should be seen as a Provincial responsibility, meriting full government attention and interest.

Still, the above model should not exclude university cooperation and possible instructional support. Arguably, the potential benefits arising out of K-12/university collaboration should not be ignored from K-12 networking planification. For instance, educational networking classroom activities lack research and data; it is difficult to discern which activities are most beneficial in a classroom setting. Furthermore, collaboration between teachers and researchers has the potential to maximize the use of networking activities by offering the two groups the means to gather and to examine collaboratively the data. Also, if Quebec decides to use the training the trainers model, where selected teachers are taught how to introduce Internet resources to other teachers, universities may play a pivotal role because of its knowledge of Internet instructional needs.

Given that McGill University Systems Inc. is no longer the Internet gateway for the Montreal K-12 community, it is reasonable to assume that GRICS, and its network, EDUPAC or RTSQ, will most likely assume the responsibility for linking teachers and students to the Internet. Hopefully, Quebec universities, particularly its education faculties, will not be excluded from participating in the planning and use of the network. After all, one of the major benefits arising out of gigabyte K-12 networking is the potential for greater academic and K-12 collaboration.

## CHAPTER 3: REASONS FOR THE PROMOTION OF K-12 NETWORKING

Literature on educational technology suggests several reasons why educators and researchers are promoting use of networks and computer mediated communication as a medium for education in K-12/university classrooms. The unreserved justifications to integrate these new resources in the classroom are surprising given the recentness of K-12 local and wide area networks. Although network facilities are commonplace in university environments, they remain rare in K-12 schools. Nevertheless, it is possible to discern a trend to design projects that incorporate the use of networks for teaching and learning with more traditional educational tasks.

## 3.1. K-12 Computer Networks and Collaborative Learning

One of most common justifications found in the literature regarding the establishment of educational networking projects is the belief that use of computer networks fosters collaborative learning. In other words, computer networks are seen as ideal vehicles for collaborative learning tasks and activities (Bump, 1990; Davies, 1988; Duin, 1991; Fowler, 1992; Fowler & Wheeler, 1995; Harasim, 1993a; Levin & Cohen, 1985; Owen, 1991, 1993; Resnick, 1992; Riel, 1989, 1990a, 1990b, 1992; Riel & Harassim, 1994; Robinson, 1993; Sloan & Koohang, 1991; Tinker, 1993a, 1993b, United States, Office of Technology Assessment,1995).

Indeed, computer mediated conferencing is believed to be particularly effective, especially in the creation of virtual classrooms (Harris, 1994; Hiltz, 1986, 1990; Kaye, 1992; Mason, 1993; Berge & Collins, 1995). Moreover, because of the flexibility and potential of the networks, it is argued that collaboration may be effected among students in the same classroom or among students dispersed over remote classrooms (Resnick, 1992), the former being the more common approach.

Some research has emphasized the redesign of the classroom to better exploit the collaborative potential in networked computers. Norman and Carter, in their study of an electronic classroom, reported that one of the primary objectives of the research design is "to increase student-to-student and student-to-faculty collaboration and group problem solving" (1994).

Initial results of projects emphasizing collaborative learning based on computer networks has led Bump to assert that "the most intense collaboration occurs when computers are electronically linked to each other to form networks" (1990, p. 49). Riel lends support to the above in her claim that the true potential of computer networks lies in their ability to create new forms of group interactions that are essentially of a collaborative nature (1990c, p. 449). Fowler, in her doctoral work (1992) and later research with Wheeler on teachers using CMC in the classroom, argued that "use of CMC changed the way the classroom functioned. In many cases, patterns of cooperative learning developed" (Fowler & Wheeler, 1995, p. 91). Still, Bump does not present data in support of his findings making generalizations from his work difficult. Only Fowler's doctoral work, and Riel's work on network-based writing by upper elementary grade students, are based on research data.

In their literature review of research on new technologies Grégoire, Bracewell & Laferrière offer the observation that "The use of new technologies promotes co-operation among students or classes in different schools, near or far, for the purpose of making them more aware of other realities, accessing relevant knowledge not strictly defined in advance, and executing projects with a genuine relevance for the students themselves, and possibly for other people" (1996, p. 18).

As connections to the Internet by K-12 schools become more commonplace, educators will have new opportunities to integrate collaborative learning techniques with new curricular activities, projects, and instructional methodologies. Sellers (1994), for example, in his guide to educational networking, emphasizes the shift from teacher-as-expert model to one of shared responsibility for learning arising from the use of computer mediated communication. A similar viewpoint is made by Hunter who argues that with the advent of the NREN, educators will have a resource where they will be able to direct and establish network projects, software, and structures to support and foster collaborative learning (1992, p. 26). Similar to Bump, however, Sellers and Hunter offer little hard data in support of their findings.

It is interesting to speculate whether the above perspective could have had an indirect influence on the final text of American legislation calling for the establishment of research and education gigabyte networks. For instance, one of the primary purposes of the *U.S. High-performance Computing Act of 1991* is to "invest in basic research and education, and promote the inclusion of high-performance computing into education institutions at all levels..." (United States, Congress, Senate

1991, Sec. 3(H)). The said inclusion of high-speed computing, however, must integrate collaborative projects among members of the research and education community (United States, Office of Science and Technology Policy, Director, 1992, p.1).

Again, collaboration is seen as being essential to the purpose and success of the project. Admittedly, collaboration among educators and researchers does not necessarily imply the structured learning methodology found in collaborative learning theories. Nevertheless, collaboration in the context used does imply appreciation that the Internet may be a suitable medium to undertake collaborative tasks. This in turn intimates that it may be prudent to structure collaboration in such a manner so as to best exploit learning activities and the sharing of knowledge, especially in K-12 environments.

The influence of collaborative learning is stated more directly in the *National Information Infrastructure Act of 1993 (H.R. 1757)*, originally proposed by Rep. R. Boucher (D-VA). In the H.R. 1757, it is possible to find a call for educators and researchers to develop, test, and evaluate educational software specifically designed for collaborative use over the Internet (1993, Sec. 307, (A),4). Still, although the intent to promote collaborative learning approaches remains implicit as opposed to explicit, the Bill does suggest that the Internet offers a virtual collaborative environment.

However, in the *National Information Infrastructure: Agenda for Action*, the Clinton administration's attempt to define its vision of the electronic superhighway, it is possible to find an explicit call for the express use of collaborative learning methodologies. A section in the report specifies "Students and teachers can use the NII to promote collaborative learning between students, teachers, and experts..." (United States. Information Infrastructure Task Force, 1992). It is possible to discern, therefore, an acknowledgement by advocates of the network that a collaborative environment necessitates a well structured approach to ensure optimal use of its resources. Moreover, sponsors of national networking initiatives perceive collaborative learning techniques to be the approach that optimally ensures maximum use of the potential in gigabyte networks.

It is interesting to note that calls for greater collaboration do not, as a rule, attempt to restrict communication among specific groups. On the contrary, current and future networking projects are being designed and implemented under the assumption that networks should foster greater communication among groups having different skills, professions, and status. And calls for greater collaboration between the K-12 sector and universities have been particularly frequent.

For instance, Michigan state's Merit network, in its introductory document to K-12 networking, states that: " We want to create an Internet-based, networked community of our teachers and students in K-12, and indeed go beyond that to a fabric joining our schools, our libraries, community colleges, and institutions of higher education" (Merit, 1994). The number of joint post-secondary and K-12 networking projects is indicative of this trend (Clement, 1992b, 1992c; Rude-Parkins & Hancock, 1990). That research has yet to validate this assumption has not hindered the establishment of K-12/university projects and partnerships.

In Canada, the CANARIE Business Plan Working Group claims that the possible linkages among schools, research centres, and universities is one of the principal benefits of the forthcoming Canadian electronic highway (Canadian Network for the advancement of Research, Industry, and Education Business Plan Working Group, 1992, p. 7). Even more, the Group asserts the said linkage is essential in guaranteeing the ability of users to cooperate in joint research while remaining physically remote from each other (1992, p. 7). And, increased collaboration is viewed as indispensable if Canada is to remain competitive in the modern international marketplace (CANARIE Associates, 1992).

Arguably, the above may well augment the need for more rigorous studies examining the impact of telecommunication technology on collaborative learning approaches. Most of the literature on the subject is anecdotal and lacks supportive data. Nevertheless, this has not diminished the belief that computer networks, especially when connected to wide area networks, create ideal collaborative learning environments.

## 3.2. K-12 Computer Networks and Situated Learning

Another reason suggested in the literature for educational networking projects is the belief that students using computer networks are able to contextualize and cognitively situate learning tasks (Lave & Wenger, 1989; Levin, Riel, Miyake, & Cohen, 1987; Mabrito, 1992; Riel, 1985; Tinker, 1993a, 1993b). In other words, social interaction and physical activity are viewed as being an integral part of the learning process. Or, the essence of learning is the result of sharing purposeful, patterned tasks (Roschelle, 1992).

Information and networking technology is also perceived as fostering a constructivist model of learning. Or, as the U.S President's Committee of Advisors on Science and Technology, Panel on Educational Technology report asserts: "Although technology is likely to find use within a number of more traditional instructional roles as well, it seems likely (though not yet certain) that the student-centered constructivist paradigm may ultimately offer the most fertile ground for the application of technology to education" (United States, President's Committee of Advisors on Science and Technology, Panel on Educational Technology, 1997, http://www.whitehouse.gov/wh/eop/ostp/nstc/pcast/k-12ed.html). And naturally, within this constructivist paradigm, "basic skills are learned not in isolation, but in the course of undertaking (often on a collaborative basis) higher-level real-world tasks whose execution requires the integration of a number of such skills (United States, President's Committee of Advisors on Science and Technology, Panel on Educational Technology, 1997, http://www.whitehouse.gov/wh/eop/ostp/nstc/pcast/k-12ed.html).

In collaborative writing projects, for example, claims are made that contextualization in learning is possible because of having an immediate audience responding to the text (Duin, 1991; Riel, 1985, 1990a); writing is not viewed as a solitary activity devoid of the social interaction present in most non-classroom activities. In addition, Cohen and Riel (1989) state that the effect of collaboratively writing for a remote audience contextualizes the work; the effort had meaning and significance resulting in superior work and deeper learning

Researchers have also claimed that through the use of networking protocols, students are able to form partnerships with experts in a domain. It is held that these partnerships can be so structured to resemble what Brown, Collins, and Duguid call cognitive apprenticeships (1989). The aim of the apprenticeship is to "embed learning in an activity and make deliberate use of the social and physical context..." so that the learning is "...more in line with the understanding of learning and cognition that is emerging from research" (1989, p. 32).

In networked environments, these apprenticeships are called teleapprenticeships (Levin, Riel, Miyake, & Cohen, 1987; Levin, Waugh, Brown, & Clift, 1994; Teles, 1993). The *Writer in Electronic Residence* project, where a professional writer works directly with the students through telecommunications, (Owen, 1993) is illustrative of this approach. This type of mentorship, a time-honoured educational approach (Riel & Harassim), 1994, p. 93), overcomes "the physical limitations of traditional apprenticeships, which result in a single apprenticeship experience being conducted in a single physical location" (Levin, Waugh, Brown, & Clift, 1994, p. 150). That is, Teleapprenticeships allow students to "participate in multiple apprenticeships via multiple roles, virtually simultaneously" (Levin, Waugh, Brown, & Clift, 1994, p. 150).

Teleapprenticeships, therefore, are mediated by access to peers and professionals in networked environments (Teles, 1993). Research concerning the benefits and effectiveness of teleapprenticeships is ongoing. Levin, Waugh, Brown and Clift (1994), working on a National Science Foundation sponsored project, examined the impact of learning in networking environments and collaborative, contextualized learning. Preliminary results indicated that: a) participants have greater time and distance flexibility; b) teleapprenticeships also appear to provide a framework for encouraging writing; and c) students appreciate the timeliness of feedback and interaction. Thus why Clement argues that the value of wide area networks lies in their potential to support collaborative projects linking educators and students that provide "meaningful learning experiences connected to the curriculum" (1992a, p. 18).

Again, more data are required to ascertain the effectiveness of teleapprenticeships. Most research remains preliminary and based on older networking applications such as e-mail. Given that many schools are presently benefiting from second generation technology like WWW servers, research needs to be more directed and innovative. For example, the effects of hypermedia, color and GUIs have only recently been incorporated into educational networking research. The technology is simply too new.

In essence, the argument found in the literature is that computer networks create virtual classrooms and laboratories where spatial and geographic concerns become secondary (Harasim, 1993b; Silva & Cartwright, 1993b). Of importance is that many educators and researchers assume these virtual meeting places can offer the student and teacher the context necessary to imbue the information with meaning. They also believe that once learning is contextualized and situated, knowledge is meaningful and, as a result, can be processed at a deeper cognitive level giving rise to greater understanding.

Note, however, that the drive to implement collaborative network based projects also stems from the assumption that this approach more closely resembles work procedures in the modern workplace (Hunter, 1992, p. 25). Mabrito argues along parallel lines in his contention that computer networks have the potential to simulate the workplace of the future (1992, p. 317). This point of view, called "new work" by Mabrito, (1992), is explicit in the Clinton administration's *National Information Infrastructure* project and in Canada's CANARIE.

### 3.3. K-12 Computer Networks and Cognitive Growth

Given the above, it is puzzling that more research has not been made on the development of higher-order thinking through use of collaborative computer network projects via the Internet. Research on collaborative non-networked computer tasks, however, point toward greater cognitive processing and growth. Admittedly, while it may be difficult to generalize the results from these studies to studies using gigabyte networking environments, they may offer guidance in the formulation of questions allowing researchers to structure their experiments accordingly.

Nastasi and Clements (1992), in their work on social processes as mediators of treatment effects on higher-order thinking, concluded that certain computer tasks -- working with LOGO in small groups -- may foster cognitive growth by promoting certain forms of social interactions, namely cognitively-based resolution of cognitive conflicts. However, it is unknown if effects on deeper cognitive processing are attributable directly to conflict resolution and higher-order cognitive thinking or to more indirect activity such as the monitoring of one's own viewpoint. Given the communicative potential of supernetworks, a valid question is whether it is possible to induce certain types of cognitive conflicts using electronic mail or other similar network activities.

Higher-level reasoning and problem solving by students in similar tasks were also found by Johnson, Johnson, and Stanne (1986). Johnson, Johnson, Stanne, and Garibaldi (1990) reached similar conclusions in a later study that examined the impact of group processing on achievement in collaborative work. Hooper (1992) lends further support to the above with his claim that intra-group reflection during computer-based instruction enhances future collaboration. Unlike the previous two studies, however, Hooper's work is primarily conjectural and lacks supportive data. Nevertheless, ongoing research appears to support claims that collaboration may promote interaction that in turn engenders deeper cognitive processing.

Educators tracking the impact of computer networks have also justified such projects on the grounds that children have exhibited greater emotive and social growth as a result of their opportunity to collaborate via networks. In her study of a collaborative networking project funded by AT&T, Riel found that children displayed greater self-esteem (1990c; 1992). In another project that linked two economically and racially different Detroit high schools, Ladestro (1991) claims that students experienced a breaking down of stereotypes and greater empathy for students of different backgrounds and socio-economic groups. Tinker, in his report of telecommunication projects, claims that "an unanticipated result reported by teachers was that learning disabled students were particularly engaged by the curriculum. The opportunities for multi-modal, rather than purely text-based learning promoted students' successful participation and, for many, enhanced their self-esteem" (1993b).

Fowler, in her doctoral dissertation (1992) and in later work (Fowler & Wheeler, 1995) found evidence that telecommunication has an impact on cultural awareness. The work, based primarily on telephone interviews with 25 teachers, all of whom participated in networking projects, concluded that the teachers and students benefited from the use of networking technology. Indeed, Fowler and Wheeler, in their interpretation of teacher interviews, state that "eighteen of them made comments that indicated that cultural awareness was an overwhelming positive result of using e-mail" (1995, p. 93).

Gallo (1993) examined the use of Internet applications on high-school teachers. Whereas subjects in Fowler's (1992) used primarily electronic mail, Gallo's subjects were given access to NCSA telnet, Fetch, Eudora, TurboGopher, HyTelnet, NewsWatcher, and Finger. Moreover, they benefited from the installation of a high speed (56,000 bps) dedicated data circuit between the high-school and Florida Institute of Technology (Gallo, 1993).

Gallo's work supports some of the above claims that use of educational networking may affect emotive growth. "Participant's continued use of the Internet," writes Gallo, "eventually brought about a more positive attitude toward education and computers on their parts, and increased their self-esteem" (1993).

Although studies by Ladestro, and Tinker lack a certain measure of rigor and are for the most part anecdotal, and only Fowler, Gallo and Riel's' (Riel, 1990a) work are based on rigorous research, advocates of K-12 networking have used them to affirm beliefs that esteem and empathy towards other groups have indeed resulted out of classroom networking use. It is not unusual, therefore, to discover projects that have components that are designed specifically to foster social development during collaborative learning tasks (Solomon, Watson, Schaps, Battistich, & Solomon, 1990).

The above outright optimism is somewhat tempered by research that examined mathematically-based groupwork with computers (Hoyles, Healy, & Pozzi, 1992). Although they agree that pupil-managed groups can effect positive outcomes concerning collaborative computer tasks, they warn that "groups must also be viewed as social systems, which, if they are to produce an agreed outcome, require a minimum level of mutual regard" (1992, p. 256). That is, in groups where there are negative interpersonal relationships, the autonomous learning engendered by groupwork can encourage the "Subjectization of the group, a centration on computer products, a curtailment of negotiation and unhealthy competition" (p. 256). This finding requires further validation, especially since most collaborative learning approaches use heterogeneous or random groupings when selecting participants for the classroom tasks (Davidson & Worsham, 1992b, p. xiii) where it becomes difficult to control the selection into groups of participants who have negative interpersonal relationships.

### 3.4. K-12 Computer Networks and Isolation of Teachers

The isolation of educators from fellow teachers and other researchers is an additional reason for the current level of support for networking projects (Tinker, 1993a, 1993b). Gigabyte networks are seen as the tools required to allow educators to communicate, share and access valuable knowledge. Those responsible for the implementation of the Texas Education Network (TENET), for example, have argued that one of the major benefits of the network is the potential for greater collaboration between K-12 educators and post-secondary educators and researchers (Consortium for School Networking, 1992; Stout, 1992, p. A-130). The few surveys concerned with this question appear to support the above assumption. For instance, in their survey of the use of networks in technologically privileged schools, Honey and Henriquez reported that educators listed less isolation as one of the benefits ensuing out telecommunication usage (1993, P.16). Or, the data appear to imply that network access may offer greater opportunities for professional support and growth.

Riel (1990c), in her study of the *AT&T Learning Network, Electronic Learning Circles*, argued along parallel lines. For instance, teacher participants showed a greater willingness to admit their ignorance on a particular subject and use the network to request information. Also, electronically linked teachers appeared more amenable to sharing and cooperating in the design of new instructional techniques and classroom organization. In this manner, support for educational restructuring is made available. Finally, similar to students, Riel claims that teachers demonstrated greater self-esteem as a result of their participation in the project.

Of particular interest is that Gallo's findings on teacher use of the Internet corroborated most research on educational networking (Honey & Henriquez, 1993; Sheingold & Hadley, 1990), namely that: Teachers faced problems of comprehension, technical problems, and time-related problems. Also of value is Gallo's findings that teacher's continued use of the Internet was contingent on what he labelled intrinsic and extrinsic factors. The principal intrinsic factor reported was excitement. Or, as described by Gallo, "The time period in which they used it was frequently referred to as play time, and they found it exciting to be the envy of their colleagues. They regarded the Internet as recreational, educational, and provocative" (1993).

The main extrinsic factors reported by Gallo are the wealth of Internet resources and reduced isolation, findings corroborated by Honey and Henriquez (1993). For example, Gallo reports that the teachers were "amazed at the relative ease with which they could communicate with individuals located throughout the world, and were impressed with the high caliber of information they received from these individuals" (1993).

### 3.5. K-12 Computer Networks and Academia

A further reason forwarded in support of K-12 networking projects is that postsecondary institutions, which often provide networking support and access, will benefit from possible collaborations. That is, the perception by postsecondary researchers that K-12 networking is "an enabling resource for research, scholarship, and (at least in local settings) education" (Clement, 1991, p. 15) is frequently found in academe.

The Curry School of Education at the University of Virginia is an example of how academia and the K-12 sector are collaborating in research projects and exchange of ideas. An electronic village was created at the University to link "teachers in the public schools, students in the teacher education program, and faculty at the university. The network environment provides a community in which these groups can exchange thoughts and ideas" (Bull, Harris, & Drucker, 1992, p. 35). This in turn can bring about renewed opportunities for schools of education to establish professional development programs that are meaningful and sustainable for both the practicing teachers and students (Breuleux, Baker & Pagliaroli, in-press; Breuleux, Laferrière, & Bracewell, 1998)

Another perceived benefit to postsecondary institutions is the conviction that higher education, and a knowledgeable workforce, depend on well trained incoming students (Clement, 1991; Allum, 1991). Furthermore, increased participation in K-12 networking by postsecondary institutions is viewed as possibly influencing legislators to support national educational goals, which may benefit all levels of education. The last held benefit to postsecondary institutions lies in the possibility of strengthening their image and relationship to the community and private industry (Allum, 1991). This may be an invaluable resource at a time of increased efforts at fundraising activities by university administrators.

## 3.6. K-12 Computer Networks and Resource Sharing

More practical reasons are also forwarded as justification for increased investments in K-12 networks. In times of budgetary constraints, it is unrealistic to assume that schools are able to acquire all materials necessary to meet the demands of the curricula, or, more importantly, to meet the demands arising from new curricula. Advocates of K-12 networking argue that computer networks create possibilities for greater resource sharing. For example, local and administrative databases, textual information, and school materials can be loaded on a central or remote server, and so eliminate costly duplication of materials. In addition, intellectual resources held by a school district can be disseminated and shared easily with other districts. Intellectual resources found in research centers and universities also become more easily accessible. Guides to Internet K-12 resources and services appear to support these claims (National Center for Supercomputing Applications Education Group, 1993).

A more functional reason forwarded for more collaborative learning networking projects is due to the cost of hardware and software. At present, most school districts do not have the means to offer individual students their own workstation. Most computer classroom activities, because of costs, demand that students share equipment. Previous studies of computer use by children have found that most students used computers in groups of two or three (Jackson, Fletcher, & Messer, 1986, 1988). Collaborative learning environments is seen as a feasible approach that can maximize learning when students must by necessity work in groups.

Finally, proponents of computer networks claim that educators and students can have access to vast warehouses of electronic information. Databases, domain experts, full text reports, electronic books and journals, graphic images and sound, and software are some of the resources that are accessible and retrievable. Furthermore, it is believed that with the advent of universal resource locators such as gophers, World Wide Web (WWW) and Netscape, retrieval and location of electronic resources can be made by novice users and children. Indeed, arguments are made that, given the exponential growth of the Internet, exclusion from these resources may hinder educators from offering their students the best possible learning environment.

# CHAPTER 4: NEW RESEARCH WITH SECOND GENERATION TOOLS

At the inception of this project, use of second generation Internet applications like WWW technology was almost unknown in the Quebec K-12 sector. At this writing, most Quebec schools still depend on first generation terminal to host technology. Still, research on the use of this newer technology, however, is becoming increasingly popular, especially as more and more schools gain lan to wan connections.

Preliminary research remains descriptive and anecdotal. Butler (1995), in his review of a course he taught using WWW server/client software, does not examine the effect of the technology on learning. Rather, the review describes the course content and the use of electronic versus traditional teaching materials. Although he alludes to more effective learning outcomes, "the on-line study hints give the instructor yet another opportunity to help students understand, explicitly, the link between the lectures and the issues raised in the textbook" (Butler, 1995, p. 33), he offers no data to support the contention. Lastly, in his supportive reference list, studies where WWW technology is the focal point of research are not cited. This, however, is not indicative of poor research; it most likely points to the scarcity of work in the area.

Gordin, Gomez, Pea and Fishman (1996) also argue that research on the use of second generation technology, most notably WWW technology, is still in its infancy. Of especial interest is their recognition that the interactive potential of the technology is perhaps one of the most important components of the technology: "The support for interactive communications is woefully underdeveloped, but is receiving significant attention and growth" (1996,http://typhoon.covis.nwu.edu/Papers/k12web.html).

## CHAPTER 5: REASONS FOR THE USE OF PARTICIPATORY DESIGN

Participatory design is a concept originating out of the Scandinavian nations (Schuler & Namioka, 1993) that has as its objective the inclusion of the user in the design and implementation of any new technology. It is a user driven design in that it "places the needs and abilities of the worker at center stage along with the other needs of the firm" (Emspak, 1993, p. 21). Participatory design grew out of the realization that traditional systems design was unable to introduce effectively new technologies in the workplace and factory floor. Or, as stated by Greenbaum when discussing the introduction of participatory design, "... over the last 30 years the pages of management and system journals have been peppered with articles bemoaning the fact that so many systems don't work or fail to do things that both managers and users expect them to" (1993, p.30).

There are five reasons to investigate the use of participatory design when implementing new technologies in the classroom. First, the introduction of any new technology into classrooms is difficult, especially in light of previous statements made about them in the past. Again, a parallel can be made with industry where technologies are introduced without worker participation. Research on the use of participatory design in industry suggests that "... local participants increased their competence on new technology and became more willing to take initiatives around it" (Clement & Van den Besselaar, 1993, p. 34). Perhaps teacher and even student involvement may foster a better understanding of the needs of the user with an optimal integration of the technology with everyday tasks.

Second, since many new projects may depend on collaborative learning activities, the decision of the teacher to combine resulting classroom tasks with use of the Internet requires an approach that maximizes their participation and cooperation. Arguably, this cooperative approach builds on mutual trust and compromise offering teachers a full say in its design and implementation. Because participatory design relies on full cooperation between users and systems analysts, it offers a ready made theoretical blueprint for initiating the activity and process. After all, a fundamental tenet of participatory design is the belief that user participation gives workers the power to influence matters that directly concern them in their work (Clement & Van den Besselaar, 1993, p. 36). And perhaps more importantly, "educators and anthropologists agree that cultures are more likely to be receptive of innovation if they believe they have an influence in its design" (Aust, 1994, p. 262).

Third, a participatory design approach has the potential to create a setting where opportunities for the researcher to share in and understand the concerns and perspectives of the participants become possible. Participatory design methodology has an affinity with research methodologies that place emphasis on interaction between researcher and participants. Or, similar to industry where, under a participatory design approach, the role of the system analyst- management consultant is transformed into a user-facilitator, the role of the educational researcher is changed from that of an expert to that of an equal participant who happens to have expertise (Carmel, Whitaker, & George, 1993, p. 46). Or, as put by Aust, "involving teachers in the planning of innovation is the first step in empowerment" (1994, p. 263).

Fourth, participatory design is attuned to current trends in education where attention to the learner and teacher, as opposed to the expert, instructional methodology, or technology, is primary. Inclusion of student and teacher needs, through their active participation in the design and objectives of the project, arguably harmonizes the need to introduce new technologies with new research approaches. As stated by Schultz and Higginbotham-Wheat, "There should be frequent feedback from teachers as implementation takes place. Teachers can identify problems before they become disasters" (1991, p. 212).

And last, use of local area networks logically[1] linked to wide area networks, or the Internet, by children has been somewhat controversial; the media have focused on isolated cases where children accessed pornographic, violent, or dangerous information. Naturally, school administrators and teachers, who have little knowledge of the network, may feel concern. Their participation in the project will allow them to understand the safeguards placed on the project and secure their cooperation.

## CHAPTER 6: LIMITATIONS IN THE USE OF PARTICIPATORY DESIGN

Most of the research on participatory design is recent and is undertaken by practitioners of the approach. As a result, there exists a serious lack of studies on its weaknesses and flaws. Furthermore, most research is restricted to industrial settings, making it unknown if participatory design has widespread applicability. Finally, North American and European, especially Scandinavian, approaches appear to be splitting into somewhat similar but separate schools, making claims about the success of the method more problematic.

In addition, participatory design closely resembles the methodology employed in qualitative research. The qualitative research tradition can be described as naturalistic, ethnographic, or humanistic. A participatory approach is likewise part of this tradition (Kirk & Miller, 1986, p. 9). Moreover, similar to participatory design, qualitative research emphasizes the need to conduct research in natural settings so that a thorough understanding of the needs and perspectives of the participants is possible. This intertwining of approaches resembles what Whyte calls participatory action research where "research and action are closely linked" (1991, p. 8). Not surprisingly, most well known participatory design projects have adopted an action research approach (Clement & Van den Besselaar, 1993, p. 29). As a result, participatory design has had to face similar criticism levelled against qualitative and humanistic research.

Another criticism made against participatory design is the imprecise definition accorded to participation. For example, Elden and Levin, in their discussion of participatory action research stress that "... the degree and nature of participation in all phases of participatory action research is a critical factor" (1991, p. 133). Indeed, they assert that not all participation is necessarily empowering, especially within a nondemocratic organization. They argue that participation must be full participation for it to be truly empowering. However, they also state that empowering participation does not mean that every person in an organization is a full participant. Rather, participation is dependent on representation by union members, managers, and top management. But representative participation is not synonymous with pluralistic participation, especially in non-democratic organizations. And many adherents of participatory design believe that pluralism is one of its fundamental principles.

Finally, attempts to define the users of the system has likewise posed problems under a participatory method. Carmel, Whitaker, and George accept the idea that "an unambiguous definition of user is impossible" (1993, p. 40) and claim that the main difference between the many different participatory methodologies is the degree to which users are able to participate in the project. A single definition, therefore, is impossible. As a result, different participatory approaches, dependent on specific settings and conditions, offer many varying definitions.

Nevertheless, participatory design may offer researchers the means to more thoroughly observe processes that occur among those directly affected by the technology. Indeed, given the lack of formal studies on this subject, a more general approach where the interaction among participants is more thoroughly profiled may offer insights on previously ignored or unknown factors acting on the success or failure of technology.

# CHAPTER 7: REASONS FOR THE USE OF COMMUNITIES OF LEARNERS

The instructional program, Fostering Communities of Learning (FCL), (Brown & Campione, 1994, Brown, 1997), was designed to foster critical thinking and higher level cognitive processes: Reading, writing, argumentation, etc. (Brown & Campione, 1996, p. 290). In addition, situated learning has been one of the guiding principles behind the development of FCL. In other words, in FCL "students are required to practice research-like activities, to become involved in systems of activity that lead them to engage in understanding texts, writing to communicate, engaging in domain-situated problem solving and so forth" (1996, p. 291).

In summary then, there are four crucial components to FCL: Agency, reflection, collaboration and culture (Breuleux, Laferrière, Bracewell, 1998). Or, as stated by Bruner:

> The first of these is the idea of agency: taking more control of your own mental activity. The second is reflection: not simply learning in the raw but making what you learn make sense, understanding it. The third is collaboration: sharing the resources of the mix of human beings involved in teaching and learning. Mind is inside the head, but it is also with others. And the fourth is culture, the way of life and thought that we construct, negotiate, institutionalize and finally (after it's all settled) end up

by calling "reality" to comfort ourselves. (Bruner, 1996, p. 87).

Another crucial component of FCL is the idea that mastery of the entire topic is ultimately the responsibility of all members in the learning community or classroom. Moreover, the sharing of individual expertise to the group allows all members to understand and have access to the topic. This in turn requires all members to have fully understood the topic, either through consequential tasks or activities.

In this environment, where students are offered the opportunity to take charge of their own learning (Brown, 1992, p. 141), a new approach to conducting research became necessary. Brown calls this new approach Design Experiments, where the projects are modeled on the procedures of design sciences such as aeronautics and artificial intelligence. That is, a systems approach is necessary because classrooms are synergistic; its multiple components form part of a systemic whole (Brown, 1992, p. 143). As stated by Brown: "I attempt to engineer interventions that not only work by recognizable standards but are also based on theoretical descriptions that delineate why they work, and thus render them reliable and repeatable" (1992, p. 143).

There are many reasons why FCL and Design Experiments are of importance to the present work. First and foremost, Brown's approach offers the means to incorporate situated learning activities and cooperative learning, two learning methods that are central to this project. Second, FCL as "system of interacting activities that results in a self-consciously active and reflective learning environment" (Brown & Campione, 1996, p. 292) offers a grounded theoretical framework that may be applied in an online environment. Third, the emphasis by FCL on sharing of expertise, again, meets the criteria necessary when attempting to create virtual learning communities. Fourth, FCL encourages interaction with experts by students through the use of online systems, a basic tenet of this project. And last, the design experiments approach, because of its systemic and problem solving methodology, is a viable blueprint for a project that had to overcome numerous obstacles and problems.

New research has integrated the ideas of FCL into practice. For example, similar to Brown, the TeleLearning Professional Development School (Breuleux, Laferrière & Bracewell, 1998) bases its design on agency, reflection, collaboration and culture. Or, as stated by Breuleux, Laferrière & Bracewell:

> This telelearning environment currently supports teachers' collaborative reflective practice (pre-active, interactive and post-active phases) and knowledge building, thus addressing complex questions and perplexing dilemmas inherent in daily practice (1998, P. 5).

# CHAPTER 8: STATEMENT OF THE PROBLEM

There are two unfolding parallel events that should be of concern to educators: The constant growth of the Internet and the increasing conviction by teachers of the potential for learning, especially in collaborative teams, through the use of gigabyte networks. Of importance is the almost unchallenged belief that collaborative network-based activities promote learning and give students needed skills. Consequently, hundreds of Internet based projects have been established (Batson, 1988; Eisenberg & Ely, 1993; Julyan, 1989; Kurshan, 1990; Murray, 1993; Quebec-Alberta Telecomputing Project, 1993; Riel 1985; Sackman, 1993; Solomon, 1992; Tinker, 1993a, 1993b).

However, a good part of the research literature is concerned with learning via local area networks as opposed to wide area networks such as the Internet. Much research is also based on stand-alone machines with CD-ROMs and multi-media software. Stand-alone machines, however, lack the interactive, communicative potential of networked computers. Or, they appear to be based on the older perspective that the computer is the agent of change.

Moreover, most of the research details the processes in the classroom after teachers and students are linked to a lan or the Internet. That is, with the exception of the work by Willis on introducing technology (1991), there is a need for more research concerned with the process of implementing a technology as dynamic and as evolving as the Internet into the classroom.

The need to examine the said process is arguably significant, given that the results of how technology is placed in classrooms may directly, or indirectly, affect how the new technology will be used. This in turn may affect the result of experiments concerned with processes occurring in the classroom once the introduction and integration of the technology is completed. Moreover, as schools gain access to the Internet via second generation technology, there exists the potential for a qualitative shift in the use of the technology.

By process is meant the activities of introducing Internet based instructional activities to school administrators and teachers. That is to say, what steps are necessary to integrate successfully this technology into classrooms so as to guarantee its optimal educational use. This definition does not include planning for hardware and software, problems concerning telephone lines and gateways to the Internet, and logical links between networks. Rather, the definition of process emphasizes the methodology and design utilized to introduce and merge gigabyte telecommunications with regular K-12 classroom curricular activities, in particular, activities that employ collaborative learning tasks, whether locally or virtually.

Indeed, the disinterest shown by researchers toward the above problem is worrisome given that some estimates place the number of U.S. children with some form of local, regional, or global computer network activities at 5,000,000 (Harasim, 1993b, p. 21) . Naturally, this figure includes local area networks not logically connected to the Internet. Nevertheless, given the growing drive to interconnect K-12 administrative and educational with state or regional networks, the need for studies on the process of introducing Internet access to classroom is arguably necessary and potentially significant.

## 8.1. Assumptions

There are major assumptions underlying the literature. First, advocates of K-12 networking argue that the Internet is a potential *collaborative* education medium that enhances and promotes collaborative learning. That is to say, implicit in much of the literature is the belief that Internet not only promotes collaborative learning, but is an inherently collaborative environment.

Resource sharing, communication, dissemination of information, and exchange of ideas are some of the services available via the Internet that are forwarded in support of the above assumption. So powerful is the conviction in the inherent collaborative potential of the Internet, that policy makers have consistently justified investment in national networks on the basis that it will foster greater collaboration among different sectors of society, namely industry, education and academia (CANARIE Associates, 1992; United States, Office of Science and Technology Policy, Director, 1992; United States, Senate, 1991).

The second assumption is the belief in the efficacy of collaborative learning techniques. The present work assumes that research on collaborative learning has established a solid enough foundation (Davidson & Worsham, 1992a; Sharan, 1990; Slavin et al., 1985; Slavin, 1980, 1983, 1990) making it possible to argue for new technologies that enhance and promote the approach as opposed to demonstrating its validity.

Third, proponents of K-12 networking see collaboration among different age and education levels as desirable. Again, it is possible to discern the implicit belief that carefully structured collaborative learning projects that foster cooperation among university, high school, and elementary age students is an effective learning approach.

The last assumption is the expectation by K-12 advocates that the Internet will be an integral part of classroom activities in the very near future. Investments in K-12 wide area networks continue to increase lending support to this assumption. Indeed, the number of schools with WWW homepages is increasing exponentially parallel with the number of students having access to the technology.

Curiously, however, the above assumptions have not led to greater scrutiny on the methods to introduce and implement new technologies, especially networking technologies. Although interest and support for K-12 networking projects is high, there exists little evidence of parallel interest concerning the process of how to introduce the technology.

The following questions, derived from a review of the literature and above assumptions, will serve as the basis of this research:

1. How to introduce the Internet and its use in classrooms to school principals and teachers who have little knowledge of its resources and services;
2. How to design effective professional development environments to acculturate teachers to the Internet and create a community of learners;
3. How to integrate use of the Internet with ongoing collaborative classroom learning activities;
4. How to establish large-scale professional development programs for teachers.

## 8.2. Methodology: A Qualitative Perspective

This research has been undertaken in a natural setting with particular emphasis on understanding the participants' conceptualization of computer networks. The participants, teachers, administrators and parents are not called subjects because they were not subjected to any treatment or experimentation. Rather, they cooperatively participated in a project that they designed and directed.

Empathy with the experience and understanding of the participants became crucial under this methodological approach. If follows that greater understanding of the said perspectives was made by the researcher since school administrators and teachers were able to share in the design and objectives of the project. In essence, then, the methodology emphasized and "focus(ed) upon social processes and the meanings that participants attribute to social situations" (Borg & Gall, 1989, p. 387). As well, participants were encouraged to "engage in self-reflective learning and critical inquiry" (Brown, 1992, p. 149) where they became responsible for defining their own expertise.

## 8.3. Participants

School board administrators and consultants, teachers in elementary and secondary schools were asked if they wish to integrate the use of Internet resources with existing collaborative classroom projects. The choice of the school grade, type of activity, number of students, and type of project was a joint decision among school administrators, teachers, and researcher. Teachers were chosen from elementary and secondary schools.

The first school chosen was a suburban French immersion elementary school. The second school was a suburban high-school that emphasized a science curriculum. It also offered its students French immersion programs. Both schools were located in high to middle income neighborhoods.

Only high-school teachers participated in the design of Internet-based projects: A science teacher, a computer teacher and an English teacher. The science teacher, winner of a national teaching award, participated in the design of the first project. All three teachers participated in the design of the second project. Teachers from both schools were highly motivated and experienced. None were new to the profession.

Two projects were designed: An acid rain project based on e-mail exchanges and an environmental news project based on collaboration among the three high-school teachers. Finally, all three teachers participated in the design of an Internet seminar for the other interested teachers.

In one year, a total of fifteen project meetings and five seminars were offered to the participating schools. Twelve of the meetings were held at the high school. These meetings were the source of all data used in the project.

## 8.4. Data collection

Data collection was made through note taking, tape recording of activities when permissible, and interviews. Use of electronic mail was made when feasible. All recordings were fully transcribed and coded into categories.

## 8.5. Ethical issues

School administrators and teachers have been given full explanations of the study prior to beginning the investigation including: Explanation of the research questions and objectives; method of data collection, issues of privacy, anonymity, and ethics.

Full written consent from teachers and administrators was received. Alternate activities were suggested in conjunction with the teacher for those students that did not participate in the project. All participants had the option to withdraw from the project at a later time without prejudice.

All participants are anonymous; pseudonyms are used in place of real names. Moreover, because the nature of the data is highly personal, ownership of the data remains the exclusive property of the participant that provided the information. Access to the data was made by the researcher and the research team only. The data were coded in such a manner so as to prevent identification of participants.

Lastly, all wide area network and Internet resources used in the project were chosen by the teachers in conjunction with the researcher. The purpose of the project, the Internet protocols used, and the number of participating students were all chosen collaboratively. Extensive use was made of resources available through the Canadian SchoolNet project and other educational Internet archives and sites.

# CHAPTER 9: THE PROJECT

The basic elements of the project were established in the summer of 1992. The most difficult obstacle at the time was securing Internet access to the schools. In retrospect, it is difficult to place in context the extraordinary growth of the introduction of Internet applications in schools. In the summer of 1992, few Quebec teachers were aware of the Internet and of its potential educational applications. The number of schools using the Internet was insignificant and the projects based primarily on pen-pal type activities.

## 9.1. The Technology

At the inception of the project, second generation technology was utilized by a restricted section of the research population. At McGill university, for example, most of faculty and students outside of computer science and engineering used terminal to host first generation Internet technology. Access to new Internet protocols, like the WWW, was almost unknown. Moreover, access to 16 bit Intel-based computers needed to use optimally second generation Internet technology was limited.

The problems with first generation technology are well known: Lack of icon-based graphical user interface, command line mode necessary to retrieve resources, etc., online connection to host during entire session, archaic command language, and inability to display diacritics and other characters outside of the ASCII set. Another limiting factor was transmission speeds. Modems functioning above 2400 bits per second were expensive and relatively rare making retrieval of materials a time-consuming, frustrating experience.

The technological state of Quebec schools was and remains somewhat non-receptive to the introduction of new technologies like the Internet. Quebec school children, for example, do not have adequate access to computer equipment. This reflects the overall situation in Quebec where in 1996 a poll published by the Globe and Mail ranked the province last in number of households with access to the Internet. As well, Quebec was ranked seventh in the number of computers in the household. The acceptable ratio of children to computers should hover around 10:1 whereas in Quebec the ratio is 21:1 (Québec. Comité consultatif sur l'autoroute de l'information, 1995). To reiterate, lack of telephone lines, lack of good computer and telecommunication equipment, lack of technical support and lack of instruction all combined created an environment where teachers wishing to implement network-based classroom activities could not do so.

## 9.2. Awareness of the Internet

Still, awareness of the potential of new computer and telecommunication activities was growing. By 1992, literature about educational uses of Internet applications had increased significantly. For example, in the database ERIC, arguably the most complete database on education and educational psychology materials, for the years 1988 through 1991 the combined number of articles with the keyword Internet numbered only 94. In the year 1992, there were 89 articles published, almost equal to the number published in the previous four years. By 1993, 141 articles were published. Large increases continued: 317 in 1994, 586 in 1995 and an astonishing 780 in 1996. Only in 1997 did it slightly decrease to 614 articles retrieved[2].

Note that the search did not include other keywords like networks or telecommunications, which could have increased the number of articles even more. As well, the word Internet in the late 1980s could have had other meanings than today's worldwide network. Lastly, this figure does not include articles archived on the Internet and not included in Eric.

Articles in the popular press likewise became commonplace, albeit many emphasized that the information found on the Internet lacks quality control; pornographic or hate literature could be retrieved easily by children. The *Globe and Mail* newspaper, for example, devoted one of its first complete articles about the

Internet entirely to the dangers of electronic pornography. Indeed, the article began by stating that: "Pornographic photographs and obscene pictures dealing with the violent sexual degradation of women and children are available to virtually anyone in Canada with a computer and a telephone link" (Moon, 1992, p. A1).

The French language press published one of the first complete articles about the Internet in February 1993 (Fortin, 1993). The article was primarily technical but at least mentioned the impact of networking on education:

> L'école tombera en désuétude, mais jamais dans l'histoire on aura tant parlé de la nécessité d'apprendre, de se perfectionner sans cesse. Par le télé-enseignement, nous communiquerons avec des ordinateurs omniscients qui dispenseront, pour chacun de nous, un programme adapté à nos forces et surtout à nos faiblesses" (Fortin, 1993, p. B1).

Teachers, therefore, had reasons to remain skeptical and perplexed as to the reasons behind the network and the potential benefits of educational networking.

Videos demonstrating the uses of the Internet were also available, the NASA-produced video, *Global Quest : The Internet in the Classroom,* being one of the most popular (United States, National Aeronautics and Space Administration, Central Operation of Resources for Educators, 1993). Finally, a "For Your Information (FYI) Request for Comments"[3] (RFC) (Sellers, 1994) on K-12 networking became available in 1993. The FYI RFC offered one of the first concise documents grouping together the major questions that teachers may have on educational networking. An up-dated edition was published in 1996 (Sellers and Robichaux, 1996).

## 9.3. Project Plans

### 9.3.1. Problem of Internet Access

Such was the environment at the initial phase of the project. Problems encountered included: Lack of Internet providers for schools, lack of knowledge of Internet protocols and resources by teachers and administrators, lack of training materials, and use of first generation technology in accessing the Internet. The primary problem, however, regardless of the type or quality of the technology, was how to introduce the technology in schools and acculturate teachers in the use of the technology. Or, simply stated, how to ensure that the technology would be accepted and used optimally by teachers and students. Fostering a community of learners, then, that accessed and shared in expertise and became responsible for their learning was the objective leading to the goal: the successful introduction and integration of technology in the classroom.

The first obstacle encountered was how to link schools to the Internet. In 1992 and 1993, there were few Internet vendors in the Province of Quebec and access to the Internet was available primarily in research centers or universities. As so often happens, by coincidence, McGill University Systems Inc., was interested in expanding the user-base of their software, MUSIC (Multi-User System for Interactive Computing).

As previously discussed, the company was also interested in studying the potential use of their system in the K-12 environment. It was decided, therefore, to give selected Montreal area schools dial-up access to the SchoolNet gopher via the mainframe of McGill University System. MUSIC was the operating system used. Teachers were limited to gopher and email protocols; WWW was under development at the time.

9.3.2. Problem of Selecting Schools

During the initial implementation of the project, the general public, and by extension teachers, were still ignorant of the educational applications of the Internet. Although public awareness was growing, educational networking had made few inroads into the educational community. Moreover, most schools lacked telephone lines that could be dedicated to the project as well as computing and telecommunication technology.

The Researcher and his doctoral advisor gave a total of 29 presentations and workshops to interested schools in the Montreal urban area. As well, a presentation was made to the Quebec Catholic School Board. Furthermore, many of the presentations were made with SchoolNet personnel who were given a chance to explain the SchoolNet project and demonstrate the SchoolNet gopher.

An introductory package was created containing Sellers's *Answers to commonly asked "primary and secondary school Internet user" questions* (1994), the NASA video, *Global Quest: The Internet in the Classroom,* and a few articles on educational networking were distributed to teachers attending the presentation. SchoolNet literature and funding information was likewise included.

In the schools that voiced interest and curiosity, a follow up seminar was presented where the entire teaching body was invited to attend. From that group, it was decided to target interested teachers only, and ignore those that did not demonstrate knowledge or enthusiasm about educational networking. This decision was taken under the assumption that enthusiastic teachers would spark interest and help introduce large scale projects in their schools.

As well, in line with the participatory approach, teachers would have complete control over the project, including its design, objectives and implementation. The researchers would assist in the technical implementation and act as a resource person and troubleshooter. In fact, the researcher would be an integral part of the project so that the acculturation to the technology could proceed as quickly as possible.

Again, similar to the Fostering Communities of Learners approach, acculturation aims to encourage "newcomers to adopt the discourse structure, goals, values, and belief systems of a community of research practices" (Brown & Campione, 1996, p. 305). That is, acculturation would come through the seeding of ideas through discussion which in turn "migrate throughout the community via mutual appropriation and negotiated meaning" (199, p. 305).

The introduction began with a brief overview of the history of the Internet, its development, purpose and probable evolution, particularly within an educational context. Existing provincial and U.S. projects like StemNet and FIRN were discussed. Also reviewed were existing Canadian and American K-12 networking projects, particularly those that integrated traditional learning tasks with new technologies. A description of the Schoolnet project, its goals and objectives and funding possibilities was then presented. Naturally, emphasis was put on why schools should devote resources and time in examining this new technology.

The NASA video *Global Quest : the Internet in the Classroom*, was shown at the conclusion of the presentation. If possible, an online demonstration was presented of the SchoolNet gopher and other sites. Other protocols like telnet, especially to the ERIC database, and FTP (file transfer protocol) were also introduced. At the time, the World Wide Web was still unavailable and access to the Internet was via line-mode only.

9.3.3. Description of Projects

As a result of the seminars and presentations, several English speaking schools in the Montreal urban area, primary and secondary, voiced interest in participating in an Internet project. Their interest was aided by the availability of Internet access codes distributed by McGill University Systems Inc. From this initial group, two schools were selected: An elementary French immersion school and a high-school. The principals of both schools were contacted and an introductory presentation at the school was scheduled for the administration and interested teachers and parents.

9.3.4. The Elementary School

At a follow up meeting at the elementary school, approximately eight parents, the school principal and the person contracted by the school for computer support and advice came to discuss the possibility of implementing a project. The parents appeared to be well informed concerning the purpose and use of the Internet. They also had a good idea of the possible beneficial/harmful effects in giving school children access to the Internet. Among the parents were: Two university professors, a public librarian, two teachers, a student completing a Masters degree, and two housewives.

This direct situated approach resembles the methodology employed by Brown where she claims to:

> have increasingly situated my study of learning in classrooms, first in such lab-like settings as pull-out time (for reading groups, etc.), then in socially sanctioned settings in the classroom (reading group), and finally orchestrating, some might say disrupting, the entire classroom activity for at least one hour a day (1992, p. 153).

The meeting began with a brief introduction by Professor Alain Breuleux, the researcher's Ph.D. supervisor, on the purpose and objectives of a possible partnership between McGill University and the school. Points covered included: possible future projects, participants, collaboration with industry and academe, and support by McGill Education Faculty. Finally, it was stated that any project undertaken by the researcher was independent from any other collaborative project undertaken by other McGill researchers or Faculty. Refusal or participation in his project would not affect the possibility of participating in other projects.

Next, the advent of the Internet and its impact on K-12 education were reviewed and discussed. The history, purpose, and magnitude of the Internet were likewise covered. The researcher then spoke on the application of Internet resources to K-12 education and on how networking technologies could enhance traditional learning tasks. Types of online projects, their significance and effect, were outlined. Particular attention was paid to Industry Canada's SchoolNet initiative.

The researcher's project was briefly presented. This is in keeping with the participatory design approach where subjects have detailed knowledge of the project and its aims. As well, an explanation of participatory design was given. The manner in which the project was to be structured around current classroom activities was also addressed. Here, the problem of lack of time and resources was brought up by one of the participants. This indeed is a problem and it was promised that the researcher would assist the teacher(s) in designing the project to maximize time and resources.

One of the problems facing the researcher during the presentation was that specific details of the project could not be outlined; the project was to be designed in conjunction with parents and teachers and maybe even students. Only a rough outline, namely the use of the Internet to enhance collaborative learning techniques, could be presented and discussed. However, teachers defended this approach by claiming that it was preferable that they help in the design. Moreover, they could always leave the project if they felt it no longer met the objectives of the school or classroom.

The researcher concluded by explaining that children would only have access to the materials determined by parents and teachers. That is, there would be no opportunity for children to access controversial or pornographic materials found on the Internet. In later discussions with SchoolNet administrators, this issue was raised. They assured the researcher that every effort was made to guarantee the safety of children linked to the Internet. However, participants were warned that a 100% guarantee could not be made, there is always a possibility that children can access questionable materials.

After the presentation and discussions, the researcher made a brief online demonstration of the McGill MUSIC system and SchoolNet. Materials found on SchoolNet were shown and discussed. Navigation via a gopher was also explained. Its ease of use and intuitiveness was highlighted and discussed. An additional feature that could be of use was that MUSIC can be set to French language if so needed. Finally, it was stressed that the user would not incur long-distance telephone or Internet charges.

Here, participants had the opportunity to see how the Internet functions, how resource discovery tools like gopher searches, locates and retrieves materials and how electronic mail can be used to create collaborative projects. How these applications are used in an educational context was emphazised throughout the presentation. As well, the demonstration helped to demystify many of the points of the Internet. In particular, it helped to illustrate the richness in educational materials that SchoolNet was able to integrate and archive onto its electronic site.

9.3.4.1. Questions raised.

The question of time was one of the primary points raised by participants after the conclusion of the presentation. Several parents were concerned about the time the children would have to invest when learning how to navigate the Internet. The curriculum is short on time and they were troubled that having children learn yet another task would take time way from other important activities.

Parents were assured that the time spent on learning these new tasks would be minimal because children would be participating in small scale projects restricted to the SchoolNet gopher and some McGill resources. Both these resources function under a menu type system. Moreover, the researcher would offer full technical support during the initial week or so. In addition, teachers would receive personalized instruction and training to help them prepare for the project.

Of interest was that a parent (who was new to the school) asked if it was possible to have parents in the classroom to assist with the Internet workshops. This indicated to the researcher interest in the use of new technologies by kids. Although several parents found this a good idea, the principal reminded the committee that school policy bars parents from the classroom during school hours. Several participants acknowledged awareness of the policy.

A committee member, one of the professors and an avid user of the Internet, answered a question concerning hardware requirements. He explained that sophisticated hardware and software are not needed to link classrooms to the McGill mainframe computer and the Internet. The hardware that the school currently uses is sufficient. Professor Alain Breuleux interjected by explaining that the Apple computers owned by the school were adequate for whatever application we wished to make of the Internet. The researcher mentioned, however, that investment in higher speed modems would be worthwhile.

Once again, the problem of structuring the classroom to accommodate the activity was raised. How can only three computers, at maximum, per class fulfil the needs of the project? Also, how are the school children to be divided into groups? This reflected the commonly found concern that existing resources were insufficient to support an Internet project, particularly a project, however modest, that planned to use the interactive potential of the technology.

The researcher responded by saying that this would be decided once the classrooms were chosen and the project established. However, in no case would a group consist of more than four students. Furthermore, the computer would most likely be placed in the classroom as opposed to a special room or laboratory.

A parent raised the question of the need to restructure the classroom to better accommodate the integration of new technologies and resources such as the Internet. She argued that successful use of the Internet requires a total re-examination of how subjects and disciplines are arranged. It would be more productive if several subjects such as reading and science could be integrated. In this manner, maximum use of new technologies, which offer cross-disciplinary resources and learning, could be made. Several parents concurred. However, it was agreed that this is a long-term objective and simply not feasible under our timeframe.

The suggestion was made that a brainstorming session with teachers and parents to define the vision of the Internet and K-12 education would be useful. This led to the idea that a committee composed of parents and students should be created with the mandate to review the application and use of the Internet at the school.

The issue of French language materials was then raised. The school prides itself on being a French immersion school. However, the vast bulk of resources on the Internet is in English. In addition, France has not been a pioneer in the use of the Internet in K-12 education. Still, the Internet is also a communication medium and it would be possible to establish links with other French immersion or francophone schools, especially to francophone schools outside of Quebec. Projects could then be created that use French to the exclusion of other languages. An example is Quebec and Alberta's "Village Prologue" project (http://cyberscol.cscs.qc.ca/meq/p_telem/village.html).

A parent asked why McGill was willing to contribute time and money to this project and to future collaboration. In other words, what is in it for McGill? The researcher answered first by saying that the project was an integral component of his doctoral work. Participation by the school was necessary for him to collect data, etc. But more long-term, the McGill/school collaboration would support initiatives, both at the local and provincial level that foster greater partnerships among academe and the K-12 community. Moreover, McGill would be able to contribute more actively to new projects while ensuring a greater success rate because of K-12 involvement. The researcher mentioned that this was supported by research demonstrating that network-based projects help foster K-12/university collaboration.

The structuring of the classroom activities in close collaboration with teachers and parents was again discussed.

Again, both teachers and parents were concerned with the time constraints that the project imposed on more traditional learning tasks. It was decided that the projects would attempt to enhance existing tasks. That is, projects would be designed so as to help kids write better or read at a higher level.

The method of data collection was explained: It would be non-intrusive. The children would be observed and their messages on and use of the Internet closely monitored. The researcher reiterated that until the specifics of the classroom activity are made known by the participating teacher, the project would remain somewhat vague. That is the nature of a participatory design approach. Finally, it was also explained that all projects must be approved by a McGill Ethics Committee. The principal added that the School Board and parents must also grant approval.

McGill's commitment over the long-term was also questioned. That is, will the school lose its Internet link once the researcher's project is completed? Will McGill continue to sponsor an Internet link for the next few years?

The researcher answered that, in the short term, i.e., the next year, McGill could support the school's link to the Internet. However, this is an issue that must be reviewed and examined by the Ministere de l'Education du Québec. Obviously, a K-12, province wide network would be ideal. Funding for the network on the long-term should unquestionably come from sources other than the University sector.

The problem of children excluded from the project, either on request from parents or for other reasons, was discussed. Or, how to make the child not feel isolated and ignored when others have the opportunity to participate in the project. The researcher explained that these specifics would be decided in conjunction with the teacher and parents. Possibilities, however, include different activities by the child, participation by the child in other duties (i.e. data collection and organization), etc.

This part of the meeting ended with a comment by a parent concerning the positive aspects of the project: The school gains expertise, training, Internet access, and possibly a new way to motivate students and staff. All parents concurred that they were not against use of the Internet in the classroom per se, but were worried about its impact on other activities, etc. This part of the meeting took approximately 2 hours.

9.3.5. Training Seminars

After a meeting with the principal and staff of the elementary school, it was decided to begin to implement training seminars in anticipation of classroom projects. Two school workdays were devoted to introducing Internet protocols and services to teachers and other staff. An Apple Powerbook portable computer and a Hayes compatible 1200 bps modem were used.

Obviously, the choice of the modem was less than ideal. However, the school did not possess a higher speed modem.

The telecommunication software used was MacKermit, configured to access the McGill mainframe computer at the McGill Systems Inc. Once linked to the McGill computer, access to the Internet was made via MUSIC (Multi-user System for Interactive Computing), the interface used by the majority of McGill staff and students. The MUSIC product group created an easy-to-use, bilingual (English, French) interface to access McGill, Internet and SchoolNet materials.

The decision was made in conjunction with the School Principal to allow teachers to participate in the workshop on a "just-in-time" basis. Because most teachers had little leeway with their schedules, it was felt that if the researcher were present for most of the day, they would be able to find a free moment to access and use the Internet. Also, it was felt that one-to-one instructions or no more than two teachers at a session would be ideal.

In this manner, the teachers would be free to ask whatever questions they may have while the researcher would have the ability to show them how to access materials of interest. This approach would also allow teachers to have instruction fashioned to their level of knowledge. Teachers, then, could decide how to use, approach and search the Internet. Finally, they would have direct hands-on experience with a mentor. Naturally, while this approach offers high-quality instruction, it is very costly and time consuming.

Ten teachers participated in a course spanning 2 workdays. The average session lasted approximately 30 minutes. The knowledge level of the teachers varied: some had little experience with computers or modems while others were quite knowledgeable concerning the use of personal computers and modems. None had ever accessed the Internet, although most had knowledge of it and a rough idea of possible services and resources. Some of the teachers had attended a brief presentation we had made at the school on the Internet. Most knew about electronic mail. Regrettably, at the time of the seminars, much press coverage about the use of the Internet by kids was negative emphasizing easy access to pornography and hate materials.

The workshop began with a brief explanation of hardware and software (if needed). A brief technical introduction was given on how the connection to the Internet was made possible. Gopher, the primary resource discovery tool in use at the time, was explained in detail. Once the connection was completed, teachers were given the opportunity to use the system if they so desired. Essentially, the SchoolNet gopher was accessed via the gateway provided by the McGill MUSIC product group. Most chose the English menu.

Throughout the exercise, the electronic resources available were emphasized and indicated. Possibilities for classroom use were also discussed and highlighted. The teacher was given the freedom to explore the SchoolNet gopher without a predetermined set of instructions or pathways. They were encouraged to seek out resources that would complement their teaching or interests. There are several reasons for choosing this approach.

First, it gave insight on the SchoolNet strengths and weaknesses. That is to say, it allowed the researcher to have a better conceptual understanding of problems that may arise during unsupervised classroom usage. But it also demonstrated the richness of resources available and how the Internet was evolving. Perhaps most important of all, it allowed the teachers to glimpse into the interactive potential of the Internet and to change their common perception that it was but a static library of materials. Or, in other words, it showed to teachers the types of possible interactive projects.

### 9.3.6. The Decision not to Implement a Project

After conversations with the teacher and principal, it became apparent that the possibility of implementing a project was remote. There were many reasons for the decision to not implement a project: First, the year was 1992 and the technology was still too new. Most Internet applications were dependent on command line mode and difficult to use and understand. Only electronic mail offered the possibility of a more intuitive application that was simple to learn and understand.

Second, although the principal and teachers of the school were supportive, questions remained concerning the significance of the technology and on its potential to effect better or more enthused learning. Again, the technology was simply too primitive for the needs of the school. Arguably, line-mode access to the Internet could probably be better used by older children, especially if the activity is primarily reading and composition.

And third, the teacher most interested by the technology was transferred to another school. Although arguments were made that another teacher could provide the bridge necessary to continue the project, it was decided to wait for more appropriate technology and applications. In this manner, teachers would become better acquainted and it would be easier to integrate the technology into the school's curriculum.

### 9.3.7. Lessons Learned

This first project indicated many of the pitfalls in implementing technology-based projects in schools. First and foremost, the need for technical support is perhaps one of the most important obstacles faced when attempting to introduce new technologies. The elementary school, although endowed with computer equipment, could draw on technical support but once a week. In addition, few of the teachers had sufficient computer skills to help others with new applications or equipment.

Second, although the researcher would be on call during the project, many in the school thought that it needed still more support. It is interesting to speculate on why that would be so, especially since the researcher could be easily reached by phone or, once implemented, e-mail. This then led to an awareness of the other major problem: The need for better acculturation to networking technology and applications.

On the positive side, the participatory design approach appeared to be popular with the teachers and successful in introducing technology. Furthermore, it also offered the researcher insights into the day-to-day concerns of the teachers and students who would be using the technology. That is, it presented a blueprint of how the technology could better be integrated with traditional teaching and learning tasks presented in the classroom.

Given the above, new plans were made for introducing the technology to the high school. It was decided to have technical personnel present who would offer assistance and support. It was also decided that the researcher would be presented during the planning and implementation of the project. Last, acculturation to the technology would continue in the form of informal discussions, additional seminars, and email communication.

## 9.4. The High School

The presentation to the high-school principal, vice-principal and staff differed from the one at the elementary school in several respects. First, personnel from McGill University Systems Inc. were present to assure the availability of technical telephone support. They also assured that Internet and email codes would be available. Second, a thorough investigation of the computer infrastructure at the school was made. The high school was a technologically privileged one with a computer laboratory and a science laboratory with two computers connected to a telephone line. Last, in accordance to the participatory method, the researcher would be involved at every step of the program. As well, training seminars would be on-going and presented as needed to both the teachers involved in the project and to the students.

### 9.4.1. Initial Presentation

A presentation similar to the one given at the elementary school was made to the principal, vice-principal, teachers and parents of the high-school. Again, SchoolNet and the various Internet applications were discussed and reviewed. The McGill presentation included the researcher, the president of McGill University Systems Inc., and the doctoral advisor to the researcher.

Participants demonstrated a greater than average understanding of computer technology and the Internet. This may be because the high-school emphasizes a program of science in addition to French immersion. As well, the participants were supportive of the technology and enthusiastic about implementing a project in the school. Finally, one of the presenters was well known to the school staff and teachers, one of his children attended the school.

Most of the questions centered on support and the need for instruction. The presence of McGill University Systems Inc. assured many of the teachers and parents. Telephone support to participating teachers was promised as well as special login script programs to access the Internet. The researcher was also prepared to devote more time to the project and to participate actively in all of the stages of the project. It was decided to offer a more technical hands-on seminar to interested teachers.

#### 9.4.2. The Second Presentation

After contact with the school principal, the researcher, two staff members from the McGill University Systems Inc., and the researcher's doctoral advisor gave a seminar on the possible uses of SchoolNet to promote traditional curricular activities. Participation was restricted to a maximum of four teachers so as to offer hands-on training. Of the four teachers scheduled, only three attended the seminar.

An introduction to the Internet was unnecessary since the previous seminar offered a full explanation of SchoolNet. A brief explanation of the MUSIC system and logon procedures was given. Most of the teachers appeared to have adequate knowledge of computers (although some teachers had conceptual rather than technical knowledge). One of the first comments was if it would be possible to write an automatic logon script to SN. It was agreed that this would be done, either by the researcher or McGill University Systems personnel.

The categories in the MUSIC SN (SchoolNet) screen, access to SchoolNet, Reader News (USENET), electronic mail and gopher, were discussed and explained. Also, the reasons for limiting student access to the SchoolNet gopher was discussed. Although the full extent of the project would be designed in cooperation with the teacher, it was stressed that the teacher should keep administrative control of codes, especially since students would have access to e-mail.

At this point teachers were invited to experiment with the system. A freewheeling session where the teacher could choose the categories and resources on SchoolNet was decided over a predetermined series of exercises. It was felt that this method would offer the presenters knowledge on the strong points and weaknesses of the SchoolNet System and the MUSIC interface. Also, it would give them insight on some of the problems that teachers may have navigating the gopher.

An English teacher was the first person to test the system. Also, although she readily admitted little practical computer knowledge, she volunteered and began to experiment with the system with little hesitation. Several of the SchoolNet menus were accessed and examined. She learned quickly how to navigate through gopher menus and access the information. Conceptually, learning how to use a gopher takes very little time. Most teachers appear to be more worried about the technical details of telecommunications (setting up the modem, software, etc) than using the system once the connection is made. Indeed, although she had little computer experience, the presenters were impressed at how quickly she became accustomed to the gopher system.

Overall, the teacher appeared to enjoy using SchoolNet. She also mentioned several possible uses for her classroom and inquired on the possibility of setting up a project for her students.

9.4.2.1. Questions asked.

The teacher who initiated the hands-on session, asked during the introduction how we are able to access the Internet and if Quebec was wired so as to make such access possible. McGill Systems Inc. gave a brief explanation on how we are able to access the Internet via the MUSICM mainframe computer. As well, it was explained why the school would not incur long-distance telephone charges when accessing gopher sites located throughout the world.

The science teacher asked how a person becomes informed concerning the quality and location of information on the Internet and SchoolNet. A brief explanation of SchoolNet resources and the SchoolNet resource manual was given by the researcher. Both items offer a comprehensive listing of educational materials, Canadian and foreign, that are accessible via the Internet. Furthermore, it was explained that immersion and acculturation to the network is the best way to learn.

Next, discussion centered on some of the educational benefits arising out of the use of computer networks and systems such as SchoolNet: Contextualization of learning, cognitive apprenticeship, social awareness, and for teachers, less isolation, and greater access to information and expertise. Furthermore, teachers quickly grasped that K-12 networking was not a fad, but a technology with great potential in education. They also understood that acculturation came with using the technology.

The science teacher asked about getting help during the project should the researcher be unavailable. The McGill Systems Inc. staff answered that a programmer would offer assistance by telephone during working hours. Also, the researcher would be involved with the project during all phases.

The language teacher raised the issue of possible abuse of the system and access to controversial materials. McGill University Systems personnel answered that access to information was restricted to resources held by the SchoolNet gopher, and that those resources were carefully selected by the SchoolNet administrators. Furthermore, the MUSIC group has restricted access to SchoolNet only; students will not have access to full Internet services. In other words, all possible precautions have been made to restrict access to controversial materials.

Still, the point was made that careful project administration and supervision are essential to ensure the successful outcome of the project and to restrict access to questionable materials. It was made understood that, in a high school environment, teachers should expect attempts at abusing the system and that eventually, after completion of these initial projects, an acceptable user policy on computing should be presented to the principal. Students and parents should sign the acceptable user policy.

9.4.2.2. Reactions.

Before leaving the computer, the English teacher was heard saying to another teacher:

*"It's easy, you just have to bring down the cursor and press RETURN"*

The impression left from the seminar was that the teachers enjoyed the experience and appreciated the possibilities that the technology has potential in an educational context. This impression was confirmed by the English teacher and by the science teacher; both requested meetings to discuss possible SchoolNet projects for their classes. Also, although they seemed to believe that SchoolNet needs better materials, etc., they were very aware of the possible impact that such a system may have on learning and school activities.

9.4.3. Follow Up Meetings: The English Teacher

The first meeting was with the English teacher who was interested in implementing an Internet project based on literary analysis and discussion. From the course outline, students had to read works such as *The Great Gatsby, The Glass Menagerie* and *Of Mice and Men*. Students must also complete a literary analysis of the work using sources from female and male critics. Finally, they must read one female and one male author from a non-Western country.

The researcher outlined with the teacher, given the time and equipment constraints, the types of possible projects: Find schools that are connected to the Internet and have similar projects (schools can be American, Canadian or British); ask a university professor or graduate student to help and mentor the students with their criticism of the books; have a student work collaboratively with another student located in a remote school. Naturally, all of the above would be implemented through use of networking technologies.

It was decided that only a few students would participate in the project. The project would serve as a pilot for another project of greater scope in the coming year. Only three or four students would participate, thus limiting the administrative and organizational load. A student with solid computing skills would be invited to participate so as other participants would have support in using the technology.

Of the listed options, only the first was found appealing and judged feasible: i.e., Full acculturation to network applications was not yet possible and may have influenced the decision towards the first option. That is, virtual collaboration is a difficult concept to understand and visualize, particularly if one has not had an opportunity to use the technology. Furthermore, the idea to have a professor or graduate student comment on the work was thought to create problems. No specific reasons were given in justification of the above. Finally, because the project was to be implemented in the spring, it was felt that a collaborative project would be difficult to coordinate during the final weeks of the school year. Although a collaborative project remained a viable option for the coming year, it simply was not feasible at that point in time.

It was decided that students would find schools, through SchoolNet, with similar projects. They would discuss with students, through the use of e-mail, their responses to the materials read. Work would be done entirely over the Internet via email. Another follow up meeting was planned in two weeks, immediately following Easter.

### 9.4.4. Follow Up Meetings: The Science Teacher

The science teacher decided to involve two of his students in a pilot project. It was hoped that, through this initial project, the experience gained would allow for the planning of a project much greater in scope and planning. A meeting was scheduled with the two students where the researcher would demonstrate the Internet, gopher, and the MUSIC system. This meeting was primarily technical, although many conceptual questions concerning the project were answered as well. Essentially, the meeting would show the science teacher and two of his students how to use MUSIC mail, SchoolNet and other resources available through McGill's MUSIC System.

Several things should be noted from this second meeting. First, the teacher had almost no knowledge of Internet protocols or applications. His two students were also novices. Second, the purpose of the meeting was as much to acculturate the teacher and students to the technology as it was to introduce technical concepts and skills. Last, the researcher was the person giving the instructions, acculturation and conceptual knowledge. However, this was done in collaboration with the teacher; the decisions on how to use the protocols and what to access were decided based on the teachers questions and needs.

Other factors helped make this meeting a success. The McGill University System personnel loaned the school a 14,400 bps modem that, given the state of technology at that time, offered an exceptionally fast connection. The teacher also had access to a telephone line connected to two computers located in the science laboratory. This gave the students easy and almost unrestricted access to the technology. Also, the computer teacher took interest in the project and began to take an interest in the technology and other projects. Eventually, he would play a key role in the introduction of the Internet to other teachers and students.

An initial problem arose in that the computer's hard disk did not have sufficient space to hold the files required to logon to McGill. The software was loaded directly from the A: drive. Also, the researcher encountered busy signals when attempting to connect with the McGill modem pool. After approximately 6 tries, a connection was made. It was explained that earlier in the day they would encounter less problems in connecting.

After a connection was made, the first request asked by the teacher was for an automatic logon script. A logon script, created by McGill Systems Inc., was included with the disk and required but minor modifications. Furthermore, the teacher requested in-depth explanations of telecommunication software, terminal-to-host connections and TN3270 PF keys.

Electronic mail was the first application explained. The teacher seemed impressed by the need for administrative control of the codes and for the teaching of computer ethics when using e-mail. First exercises included sending the researcher an email and navigating the various MUSIC mailer menus. The researcher responded to the message thereby giving the teacher an example of electronic interaction and feedback.

Gopher proved to be popular and, as claimed by many, intuitive. The teacher had little problem understanding the concepts behind it and how to navigate it. The two students understood quickly how to connect with other sites to search for and retrieve information or software. Questions were made on whether it would be possible to setup a gopher site in the school.

Use of participatory design made the introduction to the technology an uncomplicated exercise. A small example of the potential in participatory design was the creation of an automatic logon script, as requested by the teacher. It demonstrated the objectives and goals of participatory design: The research and system analyst must place the needs of the user first; technical concerns are secondary.

The next afternoon, the researcher received an e-mail message sent by the teacher. Follow up training workshops were planned on a weekly basis. The teacher and students also joined the SchoolNet discussion group. Two weeks later, the teacher was ready to send an e-mail message on SchoolNet asking for participant in a project.

## 9.5. The Project and Data Analysis

In the present study, conversation was the primary mode to introduce the technology, instruct on its uses and plan for project implementation. Conversation is also a vital tool and process of the participatory design approach. Indeed, all of the data from this project are derived from conversation and question and answer interaction between researcher and subjects. The unit of analysis, therefore, is dependent on questions and answers. The context of analysis, then, is the level of acculturation needed. The constraints are dependent on these units; researcher and subject must share the same understanding and thus eliminate linguistic ambiguity.

Dore, in his research on conversation and preschool language development, argues that "conversation itself is the immediate and primary context for acquisition; that conversation is the most significant environment for learning language" (1979, p. 337). Of importance to the present work is his description of a sociolinguistic schema that a child must have in order to participate effectively in conversation.

In this schema, Dore outlines four major issues that must be resolved prior to characterizing what constitutes a conversation (1979, p. 337). First, Dore asks what is the unit of analysis and how is the unit to be "theoretically justified and operationally defined?" (p. 337). The second question is how persons interpret each other's utterances. That is, are the implied meanings recognized as a result of grammar, or by context or by "some kind of general rational procedure?" The third issue deals with taxonomy: What are the levels to be included. And last:

> What contextual constraints operate so that speakers understand each other, so that they share the same presuppositions about topics and purposes of their conversations, so that they can eliminate the inherent ambiguity of linguistic meanings and the equivocality of utterance function? (p. 338).

Of note in Dore's schema is that it offers an effective tool in the analysis of conversational data. That is, although the above work deals with preschooler language acquisition, the fourth unit of analysis is a viable model for interpreting conversations between researcher and subjects involved in the present project. Or, what is the contextual relevance of the issues discussed, and how, through the use of conversation, is it possible to create a shared social plan that allows for the acculturation of the technology leading to an understanding of its uses.

## 9.6. Major Points Arising From Data Analysis

The transcriptions that follow are selective and reflect the participant's growing acculturation and understanding of the technology. They are interspersed in italics with analytical interpretations throughout the text. Of note in the transcriptions is the teacher's ever present concern with the problem of inadequate technical support. Although at the end of the meetings of the second project plans were made to use student expertise, that approach was never implemented.

The transcripts also show a curious blend of concern by the teachers. First, they wish to gain the greatest possible benefit from the technology. Requests for more information on evolving Internet protocols that allow for more interaction are common. Simultaneously, however, all teachers restrict the scope and originality of the project because of worries about constraints on time and resources.

Last, the transcripts show an evolving familiarity and ease with the technology and its applications. After the first meetings, the role of the Researcher is less prominent and direct. The teachers use him for detail and information while developing the major components of the final project among themselves. Again, this indicates growing acculturation and awareness of the technology. This becomes especially true in their efforts to organize a workshop and seminar for other teachers in the school.

Finally, the data suggest that, to integrate successfully new technologies, an environment is needed where teachers are able to draw easily on expertise, have access to support and instruction to deal with the fluidity of the Internet and participate in a forum to discuss issues and share ideas. Moreover, such an environment can be created by the technologies that originally created the need for support and instruction.

### 9.7. The First Project

On April 11, 1994, a meeting to implement an Internet project was held with the science teacher. Also present were two students. From this initial meeting, the data suggest three concerns held by the teacher: Lack of knowledge of what the Internet is and what it can do; concern with time and access; concern with technical and instructional support. Keeping with the participatory design approach, the researcher took an active role in leading the teacher to decide on the type and scope of the project while reassuring him that he would have the needed technical and instructional support.

The rough draft of a proposal to measure acid rain was written by the teacher and students. The idea was to have other schools actively participate in the project. However, there were questions on how participation could occur, the role that the school initiating the project would have, and how to coordinate the project. As well, other questions centered on how to instruct the teacher and students on the use of email and gopher and the MUSIC mainframe system.

The teacher's concern with understanding the technology is almost self-evident in the data. This supports most current research claiming that teachers lack support and instruction to use effectively the technology. For example, during the first phase of the meeting, one of the teacher's first statements is:

*I prefer to have this code ... I want to see how it works in the school... eventually I want to understand this ... I would like to see...*

Later on the teacher emphasizes once again the need to better understand the mechanics of the Internet and its impact on the project:

*Yeah, you know, I want to see how ours work as a student initiated project, I mean, this is something for the future. Well, I want to see it done from the other way around …*

As mundane technical details become understood, the teacher begins to ask more complex questions on specifics of the system:

*Can I ask a question, Marcos? Supposing there is something on there that I want to print?*

And also:

*Everything else (impossible to hear) if we wanted to print something... and you have to, uh, they have to write themselves something on e-mail before you can print?*

While vocabulary is discussed during the meeting, the teacher interjects with requests for explanations:

*What is KIDLINK?… What's this about New Brunswick (after the researcher's comment about the efforts New Brunswick is making to interconnect schools to the Internet). I thought Newfoundland was…*

After an explanation by the researcher on uploading text vs typing it online, the teacher asked: Which way is fastest?

However, many of the questions also reflected a very general lack of knowledge concerning the capabilities of the Internet and of the protocols being utilized. For instance, the teacher wanted to send a map over the Internet detailing the results of the project: *The final results including map will be sent. Will we be able to send a map over this?* The researcher answered by stating that: *Well, we could, you could say include a graph rather than a map, because we could design a graph online. Now there are ways of digitizing a map. That is a bit more* *complicated. I don't know, we could do it. I could get ... McGill...* The teacher was then able to ask: *Couldn't we send a coordinate map? We could have a chart with the cities with their latitude and longitude and have that on the map.* To which the researcher answered: *Yeah, that is a good idea.*

The above exchange is interesting for several reasons. First, it points to the growing knowledge of the teacher concerning the Internet. But it also points to the interaction between the teacher and researcher in arriving at conclusions that are mutually acceptable. That is, as knowledge of the Internet by the teacher grows, so does the social context necessary to advance in the planning and implementation of the project.

Second, it also reflects the overriding need for instruction and support required by teachers. The level of questions and growing curiosity suggests that teachers need more than basic technical instruction on protocols and applications of the Internet. They need guidance that acculturates them to a far deeper understanding of what the technology is and how it differs from previous educational technologies.

And third, it points to the need for the inclusion of users in the development of networking materials and projects. Throughout the meeting, the teacher was able to suggest modifications, ideas and procedures. As well, the teacher knew the constraints faced by his students and his environment. The project evolved under that knowledge and guidance.

The role of the researcher in the development and evolution of this first project is also indicative of the issues arising when introducing networking technologies. For example, from the beginning, the researcher accepted a role encompassing more than advice giving. In the description of the project to be sent over SchoolNet, the researcher offered to: *look over the proposal and then send it over and see if anyone wants to do it.* And later: *what I need to know is: Are we ready more or less to edit the project?*

Also, acculturation to the Internet was possible through examples and explanations made by the researcher. Linkway, the IBM software, was explained in these terms:

Researcher: *Linkway is a piece of software created by IBM that is based on hypertext. Do you know what hypertext is? It allows you to navigate text, like in a book, in a non-linear form. You know how when you read a book you have to go chapter by chapter? When you have hypertext, suppose you find a term that interests you, you can click on the term and you can find information that relates to that term. So it doesn't have to be in a straight line.*

Hypertext, a system on which the protocol of the World Wide Web would be based, was easily introduced.

Again, the data indicate direct intervention by the researcher during the implementation of the project. However, the intervention is always tempered by the wishes of the participant; the objective is to acculturate and help to implement a mutually acceptable project. By mutually acceptable it is meant that the researcher is able to support and meet the educational needs of the participant.

For example, it was decided that the project would be a small-scale one allowing the teacher to acculturate himself to the Internet. Only two students would participate. As well, the project would entail use of email only; other more interactive protocols like gopher or FTP (file transfer protocol) would be examined during the planning for the next project (although the participants were free to explore them if they so wished). Many technical questions were also raised, the problem of creating a map being a case in point.

The following conversation between researcher and participant illustrates the evolution of the social planning required for the implementation of the project.

First, the Participant describes the project and some of the editing changes to it:

*Participant1: Okay, well in terms of the way you wrote this up this looks fine, I made a few corrections on the grammar, I left this out, it's your city, town... and you know, under other* *comments you may want to write up some stuff, spelling error here corrected... and what did you want to put here? International acid rain? … So put... and we are changing this to grade 6 to grade 12? Okay. The summary, is just as you have written it. How to register... Now that may be ...*

The researcher intervenes with a small detail:

*Researcher: Yeah, then write to your e-mail address. And you can also put my e-mail address as well. You know, say that I am the technical support or something.*

Participant agrees and asks if he can proceed:

*Participant1: Okay, so can we enter all that in now?*

Researcher brings up question of the need for an introduction:

*Researcher: Do you have, like uhm, an introduction? Oh perfect! Excellent!*

The intervention becomes more direct and emphasis is placed on the need for an introductory statement at the beginning of the text:

*Participant1: That is going to go in here, right here somewhere. This is the way they want it.*

*Researcher: Actually, I would like to have, I think it would be a good idea, you don't have to say it this way, but I think it would be a good idea saying "hi, we're two students from Montreal* *participating in an acid rain project. Below is our project and we are looking for collaborators over the Internet.*

*Participant1: They are saying that right here: We are two grade ten students and...*

Again, the Researcher intervenes and attempts to convince Participant1 of the need for a more salient introduction. The exchange also illustrates the negotiative approach of participatory design. That is, regardless of the vigor of the intervention, there is always room for participation and compromise:

*Researcher: But that doesn't come in the top... you just need a sentence: Hi we are two students from … in Montreal. We are participating in a project and we would like some help, no, we would like (Participant1: Collaborators) collaborators. Then you write it up. And you can even leave this...*

A compromise is finally reached with Participant1 satisfied with the conclusion:

*Participant1: And then here, here, you can start from this paragraph. The schools involved will be asked ... okay?*

*Researcher: I think, I think it is a good idea because from just knowledge of this a lot of times people just look at the very beginning and say "Oh I don't want to, you know... just a project" and delete it instead of going all the way down...*

*Participant1: Yeah, we just read the first few lines... So what did you do? (Researcher: I just did ENTER) So that the computer knows...*

The Participant then stresses his need for more knowledge about the project and its implementation and administration:

*Participant1: Yeah, you know, I want to see how ours work as a student initiated project, I mean, this is something for the future. Well, I want to see it done from the other way around*

*Researcher: I know the head of the K12 network in Finland. Do you want me to communicate with him to see if there are any schools there that would be interested in participating?*

Participant1: Sure

*Researcher: What I'll do is send you the message because I don't know if he is on SchoolNet or not.*

By the end of the meeting, a message requesting that participants join an acid rain project was sent out through SchoolNet. Deadlines, objectives and timeframe were included in the message. Perhaps most important of all, participatory design facilitated the creation of the environment where both participant and researcher were able to agree on the mode of interaction and intervention. The project was conceived, designed and implemented by the teacher. However, it was guided, explained and co-implemented by the researcher.

9.7.1. Subsequent Meetings

As the project progressed and reached its conclusion, the researcher and participant met to discuss project strategies and needs. The data from these meetings suggest that acculturation and introduction to the significance and potential of the technology remained the primary challenge to overcome. This is reflected in the following conversation.

Here, the Participant inquires about the significance of the responses to the project received:

*Participant1: How do you feel about the response they had? Twelve schools ...*

*Researcher: It was good. I was a little surprised that there weren't more overseas. I think the problem was that we announced it primarily in Canadian and American groups. Maybe also the fact that we started it a bit later?*

The Participant raises the question of access to hardware, a serious impediment to enlarging the project:

*Participant1: Yeah. The one problem I had with all of this was that they tie up the computer … If I was to broaden this to other groups working simultaneously, logistically...*

*Researcher: What I could do is get you old computers. But I don't know if you want that.*

*Participant1: No. You know, the other problem is the amount of space we have and the telephone lines and the other kids in here doing other things. This computer... there are other programs on there. Other programs on this one. We have a lot of CD-ROMs coming in too.*

The researcher takes the opportunity to introduce new technologies and access methods:

*Researcher: The solution would be a real network.*

The Participant answers by raising questions on how to expand the project:

*Participant1: What I would like to do next year is have, you know, I assign projects, environmental projects at the beginning of the year. And I would like to have some of the students exercise the option of doing this kind of thing as their project. Where I would give them a month or so ... so we might have five or six kids over the year that would have access to the computer. We would have to wrap up the whole project ... That's the only way I can...*

Next, the Researcher raises the question of collaborative learning. Or, did the Participant explicitly introduce the concept in his statement:

*Researcher: Did you write this? Did you throw in the word cooperative?*

Of interest is that, through his response, it is possible to see that the participant is becoming slowly acculturated to the vocabulary and potential of the technology. That is, his response implicitly suggests that he is beginning to understand the difference between asynchronous and synchronous electronic communication:

*Participant1: Did I personally do that? Well, what I enjoyed is being able to facilitate the students to do this. I think it is worthwhile for them to be interactive ...*

Following the discussion on expansion of the project, the problem of access to the technology was raised once again. This exchange is significant for several reasons. First, it shows growing awareness by the Participant that access to the technology has a direct impact on the quality of the project. Second, it implicitly points to the participant's goals in having his students use the technology. And last, the Participant appears to understand that his role as a teacher may change significantly as a result of student access to the technology.

In this section, the Participant begins to express his concern for more meaningful tasks with the technology:

*Participant1: That's the other aspect of what I wanted them to use this for. I wanted to have ... and we didn't do any of that here, this time around.*

*Researcher: Well, we could teach them how to search databases ...*

In response to the Researcher's suggestion to search databases, the Participant raises the problem of access. Again, the growing acculturation is reflected through his understanding of the potential of the technology and how his lack of access limits that potential:

*Participant1: But again, the limiting factor is the physical access to the machine. We only have two of these machines here and 120 students. This telephone is expensive we are paying $50. That's a big chunk of money out of my science budget that I have ... $5000 ... one hundred dollars a month is a lot.*

*Researcher: I don't see why Bell doesn't give schools a better deal. Well, I have to come back sometime in the summer when the term is over and you have some time because I have to interview you and I have a number of questions ... I can just in touch.*

The Participant is then able to modify his expansion of use of the technology accordingly:

*Participant1: Well, you know, I control these, I can give SchoolNet priority to these. As long as I have no more than four kids in one project ...The ultimate solution is ... essentially, this is my class computer and my class is right here. But at lunch time, this is a busy place.*

*Participant1: You know what, give them a specific date as to when they are going to send this in. Yeah, in your message say that you* *are waiting for the last few respondents and we are going to put it all together and you should expect to receive your data by June the sixth which is our last day of school. Because after that … Yeah, So we now know that we have a commitment to get all this out by the end of the day by June 6th. Okay? Because I want you guys all finished before ...*

Later, the Participant is able to raise questions once more about his expectations concerning the use of the technology. He also states that he knows what goals to reach for. Of interest is his growing ease with the technology, the jargon and the use of the Internet in his class:

*Participant1: I'm looking at the ... aspects ... but also I want to link up with experts.*

*Researcher: I might be able to find a PhD student who has an interest in education and maybe the students can communicate with him ... that is something that is interesting as well.*

*Participant1: have to see, you know. I won't be able to assess how many students will be interested in this ... I know what I am leaning towards.*

And, again, at a later section, the conversation suggests growing acculturation, ease with the vocabulary and focused goals:

*Researcher: You guys got to play with the SchoolNet gopher?*

*Participant1: No, they were very focused with just this. That is something I would like other kids to do.*

*Researcher: We could design like a (Participant1: A plan of activities?) yeah, find this, what is the value of Japanese yen?*

Throughout the conversation, the Participant's acculturation with the technology is more pronounced. He understands the precarious balance teachers must reach to introduce the technology to their students. Moreover, he also explicitly understands the capabilities of the technologies and the constraints under which he must work.

At this point, the Participant emphasizes his objectives concerning future projects:

*Participant1: What I would like to see is this running on its own. Because in terms of the amount of time I can devote to this and I would have to learn it myself, I don't have enough time either.*

*Researcher: I don't think there is much danger in someone abusing the system.*

*Participant1: No, I'm not worried about that. I have been monitoring this. Kids have come in here and have switched to the bulletin boards and I watch what they are doing and it is all very fine stuff.*

*Researcher: It's like a telephone...*

Here, the data point directly to his increasing familiarity with the technology and acculturation:

*Participant1: I am not as uptight about that as I was initially. Just based on what I see happening here. The only thing I want to do is not to get overloaded with this. I feel that by having .. designated to use the machines ... no more than four... I think the kids themselves could can come up with a project that they want to do. Before I let them get on the machine I'll be asking for proposals... You know, I asked for was a computer with a CD-ROM (speaking of the PowerPc). We could have used any...*

*Researcher: How do you go to DOS, do you know?*

*Participant1: The kids know. (Laughter) These kids come in the morning and they are laughing in here... I'm very excited about the CD-ROMs that we got. I have one, the Tropical Marine ... kids actually go on dives, there are different stations underwater. Then they have to generate a report.*

*Researcher: I think the project has gone quite well.*

*Participant1: Yes, yes.*

*Researcher: We got sixteen ...*

*Participant1: It was a good way for all of us just to learn, to get rid of some of our inhibitions about using it.*

Finally, at the end of the conversation, discussion the teacher turns to introducing a new project to his students. Of note is the interaction between Researcher and Participant leading to the possibility of an expanded, more interactive project that more closely meets the Participants needs. Also of importance is the growing complexity of questions and interaction reflecting greater acculturation to the vocabulary and potential of educational networking technology.

First, the Participant responds to the possibility of using computer savvy students for support and instruction in the next project:

*Participant1: I'm sure there are a number of kids that ... I'm not worried about getting hung up on the technicalities, particularly if you have some kind of manual to help us.*

The Researcher begins to introduce the possibility of more interactive projects, different from the email based project almost completed:

*Researcher: A science newspaper would be interesting. Where your students would get to read scientific news Yeah. Their research would be science in the news and then maybe in conjunction with the English class they would have to write that up and post it electronically.*

*Participant1: Well, that is a possibility. I have kids doing that. We have ... it is a project option... assign it to a youngster whose job it is to find articles in newspapers and turn them into* *scrapbooks at the end of the term. Having an electronic version of that where they would have to summarize the article.*

*Researcher: Well, the interesting thing would be for other schools around the world where we could get science news and we could post their news...*

In this next section, the Participant analyzes the suggestion, supports it and requests additional ideas or possibilities. Arguably, the acculturation to the technology is demonstrated by the Participant's implicit understanding of the impact that the activity may have:

*Participant1: But I want them not to post the whole article. I want them to summarize them. What they find in the newspaper. That is an excellent idea. I like that very much. They get credit for writing the article. But I like that idea very much. And, uhm, you got any others?*

*Researcher: Yeah, it is just talking like this that we come up with them.*

*Participant1: There's no ...*

*Researcher: Limit to it.*

Once again, the constraints caused by limited access to technology is raised. While the Participant is enthusiastic, the Researcher raises once again the constraints caused by the lack of access to networking technology:

*Participant1: Yeah. I wondering if there is some suggestion. Like for science fair projects. I wonder if there is some kind of book of suggestions. There is nothing out there in the literature. Well, this is excellent. The scrapbook idea.*

*Researcher: You see, the problem for a really innovative project is that you have to have a network.*

*Participant1: Yeah.*

*Researcher: What we could setup is that we like a database here or gopher system or anything where other schools could communicate. But we are limited to one telephone line there are limits to the types of activities we can do.*

The Participant and Researcher then tackle the problem of time constraints; students have many other competing activities and cannot invest much time on a new projects. The Researcher uses this opportunity to introduce the possibility of integrating the new activity with traditional learning tasks. This section illustrates how the participatory approach assists in keeping the project within reasonable bounds, given certain constraints:

Participant1: *You also have to remember that the students themselves don't have the time that they have to get involved* (Researcher: *That's right). They have so much on their plate.*

*Researcher: Well I think that the secret is to incorporate it to traditional learning tasks.*

*Participant1: Using SchoolNet seems to be one of the options ... I don't expect the whole class to ... That is why I think the scrapbook idea to be wonderful.*

Stressing that the value of the new activities is its interactive potential, the researcher suggests new approaches that may make the project more effective. Of particular interest is the implicit support received from the Participant. Again, the potential of the technology is implicitly understood:

Researcher: *Yeah, I would like to see if we can make it interactive as well. It would be interesting if we could get the science news published in conjunction with a couple of schools. For instance, here we could have two editors and then have two editors at another school and two other editors in the six schools and they decide the best news from all the class. So, your entire class feels ... whatever they think is best they will put it together in a newspaper (*Participant1: *And send it out) and send it out to the schools.*

*Participant1: And you are welcomed to send out the entire article or some ...*

*Researcher: No, it would be condensed, an abstract. But actually, I would imagine, will write the abstracts. So, if they receive 30 abstracts, the six editors will go through all of the 30 abstracts and choose the most interesting ones for the newspaper.*

The interaction between Participant and Researcher continues and ideas are discussed. Again, of importance is the dialectic between the two, the growing acculturation fostering greater familiarity with the terminology by the Participant and the implicit recognition that continued interaction among participants is an essential component of an effective Internet project:

Participant1: *Then I could change the focus of the environmental project where the whole class would be involved in this* (Researcher: *Yeah)*.

*Researcher: That would be interesting for the Science Fair, for instance, an electronic science newspaper among three schools in three continents. We could have one in Australia, one in Europe...*

*Participant1: Can we get the distance ... Because here we only access people in ... most were from Canada online. I think that would be great if we could get people on each continent.*

*Researcher: I can try to get people from South America. I have a contact from IBM ...*

*Participant1: Will the communication be in English?*

*Participant1: They have to make their abstracts ... Well, if we wanted to pursue this as a year's project, it would be very ... to make it exactly and environmental project. I have two classes next year.*

*Researcher: The problem is I won't be able to come back and work next year. So I don't know how much support I can give you. I'll speak to Alain and see if there is a student who could take over.*

At this point, the participant understands that this is a major obstacle.

*Participant1: We need someone who can help us with the technical aspect.*

*Researcher: Right.*

*Participant1: To show them how to send out a mass mailing, the glitches. The actual ...*

*Researcher: We will be drawing up the education ...*

*Participant1: Once that is done, if we could have a support person who come in once a month and if we knew he was coming in, we could save our questions.*

*Researcher: There is a help desk that you can call, (the programmer at the McGill Systems Inc. group).*

*Participant1: Yeah.*

*Researcher: Did you ever use it?*

The enthusiasm shown by the Participant becomes explicit. As well, although technical support remains a concern, it does not seem to pose an insurmountable problem.

*Participant1: We never had any glitches. These kids pick it up quickly. They knew you were coming in, it was timely no for them to learn how to send the messages. I'm starting to like this.*

*Researcher: Let's think it over for next week, then. ...*

*Participant1: It all hinges on getting participants.*

*Researcher: There's a mailing list called Kidsphere with people from all over the world. So we could send out a message on that and ask...*

*Participant1: The class, kids in the class, would come with a ... the editors would abstract these?*

*Researcher: Maybe the kids would come up with articles and write the abstracts. Otherwise the editors (*Participant1: *Yeah) would abstract 30. The editors ... choose five articles or abstracts, they would put everything together and the newspaper...*

Participant1*: And they would have to type it (*Researcher: *Yeah) and send it off.*

*Researcher: You have a wordprocessor? Yeah, I'll show you. One of the kids here must know how to do it, too. And when the newspaper is published, I think it would be really fun just to print it out and post it on the bulletin board. I think the kids would like to see their abstracts (Participant1: Yeah!) News From Australia, New From Europe and News from us.*

*Participant1: it is a wonderful idea. The more I think about it, the more I really like it. You just thought of this, off the top of your head?*

*Researcher: That's the type of thing you can do. (Participant1: Yeah)*

Participant1: *And it is more meaningful than what we have been doing with this ... But I specifically wanted it that way for the first project so that I could see the mechanics of how they would be using it. Okay.*

*Researcher: So we can work out the details in our next meeting. (Participant1: Yeah).*

#### 9.7.1.1. Lessons Learned II.

The project ended on a successful note. The Participant felt that the primary objective had been achieved: To gain insight into the administrative, educational and human resources required to implement an Internet project. In addition, the participant also felt that he gained knowledge about the applications and use of the Internet.

Perhaps more important was the fact that the Participant understood the potential inherent in the technology. As reflected in the data of the next project, the interactiveness of the technology offered an environment that could be tailored to his educational objectives and needs. Moreover, he also gained an understanding of the constraints: Lack of adequate support, lack of telephone lines, etc.

Also surprising was the speed with which the Participant gained acculturation to the use of Internet applications. That is, he understood rapidly the implications, requirements and needed behavior when using Internet applications. He also saw how a more interactive project could optimize many of the traditional learning tasks. Finally, the possibility for more collaborative work among teachers and students from different disciplines was also made clear. Teachers were becoming acculturated to how the technology can be used in conjunction with collaborative classroom learning activities. Or, in other words, it became possible to initiate the fostering of a community of learners concerning new technologies.

Still, the project demonstrated that technical and instruction support are essential to the success of any Internet activity. As well, the technology was too primitive to implement more user friendly activities (creating online maps, for instance). Last was also the realization that the curriculum needed review; the project was an added component rather that an integral element of an activity.

## 9.8. Meeting with Science Teacher, Computer Teacher and English Teacher to Design New Projects

At the completion of the initial project, several other teachers voiced interest in participating in follow up Internet projects. A meeting was held with three of these teachers: The science teacher (Participant1) responsible for the initial project, the computer teacher (Participant2) and the English teacher (Participant3). It was decided that we would hold a joint meeting to discuss the possibility of implementing a cooperative project among the three disciplines.

The data from this meeting should be noted for three reasons. First, the acculturation of the science teacher (Participant1) to the technology allows him to take a lead role in introducing networking technologies to his colleagues. Participant1 became the expert as well as a co-learner and co-teacher. Of interest is that the introduction goes beyond mere technical details; the science teacher is able to articulate the impact and significance of the technology and to suggest possible collaborative projects among the three. Second, the role of the researcher is much less prominent. The science teacher, because of his increased awareness of the technology, was able to formulate ideas and suggest projects with little help from the researcher. Third, the English teacher was able to articulate the concept that the technology should enhance, rather than replace, traditional learning tasks. Reading, writing and collaborative work would be the foundation of any new project; the technology would enhance collaborative learning tasks.

For instance, at the beginning of the meeting, when speaking of his project, Participant1 states that:

*Mine, yeah, mine was quite a bit more limited in scope because I know what we are able to do with the resources we have. My plan has an environmental perspective. Marcos, actually it was Marcos who gave the direction on this. In my biology classes I'm going to assign different newspapers for my students to monitor, snip out the articles related to the environment, some kids on the "Suburban" some kids on the "Monitor…"*

Participant3 then inquires about language. Of interest is that Participant1 responds by assuming a much greater knowledge of the Internet by Participant3. Implicit in his answer is that the project would encompass foreign regions:

*Participant3: French newspapers too?*

*Participant1: Well, we could do that. The kids certainly have the facility in the second language. So they would bring these articles to school and I would have a team that hopefully would edit the articles, categorize them by the type of environmental problem they are dealing with and we would send summaries of these* *articles to the other schools across the system and they would be doing the same thing in their own...*

*Participant3: When you say across the system, what does that mean?*

*Participant1: Well, it would be worldwide.*

*Participant3: Worldwide, okay.*

*Participant1: Well, for example, this year we even had a school from Malaysia participating in our acid rain project. Most of the students tend to come from schools in the Maritimes or in the Western part of the USA.*

Furthermore, Participant1, in his suggestions for structuring future projects, explicitly understands the technological constraints they will be working under. That is, only a few students would be using the computer, but all students would participate in the project:

*Participant1: But the reason why this I think is a practical project, because we would only have one or two students sending the information out over the phone lines.*

*Participant2: Right.*

*Participant1: So we wouldn't need a lot of access to the machines. We would only have a few kids actually sending the data out. But everyone would be involved in the project in one way or another. Whether by collecting the articles, or by summarizing them, or placing them in categories.*

Of particular interest is that at this point, Participant3 asks Participant1 for his opinion on possible projects involving her students. In other words, Participant1 accepts a leadership role and the ability to influence. This new role is arguably a result of his growing acculturation to the technology. To reiterate, acculturation does not indicate technical knowledge; it reflects familiarity with the vocabulary and knowledge of the potential impact of the technology.

*Participant3: Alright, twelve. It doesn't matter because they didn't do this last year. So it's another program. How, practically, how would you involve the English.*

*Participant1: Well, we could have them, we could give them the article and have them make the summary.*

*Participant3: Okay, okay...*

*Participant1: And we would take the summaries back and categorize them as to the type of environmental problem (Participant3: sure) they are.*

*Participant3: Fits in with the skills we teach.*

In the following exchange, Participant1 is comfortable enough with his newly acquired knowledge to challenge the Researcher on the design and goals of the project. The contrast with the first meetings is significant:

*Participant1: The thing about it is, you know, it is practical to do given the hardware that we have to work with. Because only three or four kids would be downloading files and sending them to other schools.*

The Researcher intervenes with some suggestions for organizing the project. The purpose of the intervention is to promote interaction and collaboration in the design of the project.

*Researcher: The problem is how we would organize this with the other schools. Because they would be sending articles as well. So, would you want the editorial board to be in this school here only, or would you like to have a virtual editorial board with people from all of the participating schools.*

However, Participant1 argues for a more limited role as a result of his understanding of the constraints they must work under.

*Participant1: The way I foresee it the other schools would do their own editing. It is only at the end of the project that we would exchange our data with one another.*

Insisting of a more collaborative approach with other schools, the Researcher intervenes once again:

*Researcher: But wouldn't you like, uhm, say a small news...we will call it a newspaper, local newsletter, published every week? Or* *every month? Wouldn't that be objective? Like every week you would post the new Environmental News, you would post it.*

Still, Participant1 is able to voice his concerns and insist that a modest project is more feasible:

*Participant1: I would rather see the newsletter the final product at the end of the project.*

*Researcher: Just one single newsletter? Because I thought you wanted a weekly, you know, the news this week.*

*Participant2: A weekly would be impossible. Once a month might work, if we limit it to three articles each, or something.*

*Participant1: I think we have more flexibility if we leave it to the end. We see what we get, and see how we want to ...*

As the meeting progresses, Participant1 is able to mold the emerging project according to his needs, have the researcher act as a consultant and advises Participant2 and Participant3 on feasible projects:

*Participant1: I don't think you realize the constraints ...*

*Researcher: That you guys work on?*

*Participant1: There are not only constraints with hardware but there are constraint with the time students have to do this. They have many other things to do that...*

*Researcher: Because one of the problems with the networks is that if the students don't get immediate feedback using the networks,* *it gets boring very quickly. So, I don't know if receiving abstracts of the articles are considered feedback.*

*Participant1: Maybe we could send just abstracts, categorizing them as we get them.*

This next exchange reflects the advisory role taken by Participant1. Note as well the absence of the Researcher, both as consultant and as former project leader:

*Participant3: Would this be done during class time or is this extra curricula?*

*Participant1: I would see it as during class time. They would obviously miss other things going on the classroom, but...*

*Participant3: Are you going to take students out and just have a few students ...*

*Participant1: I'll just have a couple of students coming in here ...*

*Participant3: Because I could give these articles to a class of students and have this as an exercise, teach summarizing, precise writing, and they can do it as a class and we could pick the best ones for you.*

*Participant1: The articles will come in dribs and drabs.*

*Participant3: Right.*

*Participant1: And you know, they only get the newspaper ones ...*

*Participant3: Right. That's okay, I don't want...*

The researcher finally intervenes:

*Researcher: You don't want to send them to the library to look at the Gazette? The Globe?*

*Participant3: We only receive the Gazette. We are part of the Gazette program, we receive twelve a week.*

*Participant1: Gazette is only one newspaper we want them to look at.*

*Participant3: Yeah.*

*Participant1: I want them to look at local suburban (Participant3: uhm, uhm) newspapers.*

*Participant3: Because the local areas really concentrate on issues. That is where you have your protest groups.*

*Participant1: Yeah, pesticide issues, all kinds of grievance groups that are active in various communities. We want to see if they ... the same level of activity are occurring in other communities.*

*Researcher: Interesting.*

Again, note how Participant3 turns to Participant1 for advice:

*Participant3: How often would we use the computer? I have no idea how often this happens.*

*Participant1: Well...*

*Participant3: They edit, they get the material, they read it, they edit it, goes back to your group...*

*Participant1: And then we could transmit our abstracts to the participating (Participant3: Okay) schools. And they would do the same for us. I mean, I would see doing that maybe once a cycle? Once every seven days? (Participant3: Okay)*

*Participant3: When do you get feedback from? These people you send things to?*

*Participant2 I'll be trying to get my kids being able to feel comfortable with the Internet (Participant3: uhm, uhm).*

At this next intervention by the researcher, emphasis is placed on a collaborative approach to implementing the project. The important point to note in this section is that Participant1 does not question the Researcher, thereby demonstrating an implicit awareness of the issues, and continues afterwards to structure the project according to his perceived needs:

*Researcher: Yeah, uploading files. It's pretty easy. What would be interesting would be if we could use Participant2's kids as the support technical staff for your kids that are using the computer (Participant1: Exactly) so we could have a collaborative group where one set of kids that are already learned and are familiar with the Internet are helping these other kids use it in their work. So we have one set whose job is really to learn the technical details of uploading and so on. And the other group that* *is not really concerned with that wants to use it as a resource. and I think that would interest learning by ...*

Immediately following the intervention by the Researcher, the Participants begin to discuss the potential project once again:

*Participant3: You've got a very good example of cooperative learning (Participant1: that's right)*

*Participant1: (To Participant2) But do you have students with technical expertise?*

*Participant2: That's where you got ... how many do you need? Two?*

*Participant1: Well, I have two students who will be in grade eleven who know how.*

*Participant2: Well, no. I was thinking of people like Student1. You are not talking at that kind of level.*

*Participant1: But even Student1 and Student2 do not know how to download stuff from wordprocessing, wordprocessing program into SchoolNet.*

*Researcher: It's very simple.*

*Participant2: It is something that they haven't practiced.*

The following brief exchange is interesting because of the independence from the researcher shown by the Participants. Also of note is the changing role of the Researcher. This supports Norum's suggestion that "when online classrooms are implemented in a classroom or school, the roles of the student, teacher and administrator all change" (1998, p. 72). Or, as "students are asked to take on increasing responsibility for their own learning, the relationship among staff, administrators and students shift considerably" (p. 72). That is, the Researcher continues to play a role, but far less intrusive than previously:

*Participant3: So it won't be possible for me to do that with the project?*

*Researcher: Sure it will.*

*Participant1: It is possible.*

*Participant3: It is just that I don't know anything about this.*

*Participant1: I just want you to realize the constraints of the machine.*

*Participant2: Now, if you decide you are going to do this (Participant3: Uhm, uhm), then there is no teacher out there that picks it up in the first week, you are stuck. Nobody wants to receive your messages.*

Further evidence of growing acculturation is reflected in this next exchange where Participant2 is able to suggest joining an existing project:

*Participant2: What about just responding to everybody else's project?*

*Researcher: We don't know if there will be one that is similar to the one we want to setup.*

*Participant1: There are projects out there ... everyday.*

*Participant1: I'm particularly interested in my environmental project.*

*Participant2: I thought this was interesting (showing a project printed from SchoolNet). Up your alley. It's mostly American. They have people all over the world to take measurements about the weather, basically, and send it ...*

*Participant3: Didn't you do that this year?*

*Participant1: We did just the acid rain...*

*Participant2: Just the acid rain. I guess you have seen it already.*

*Participant1: Yeah.*

And here, Participant1 again emphasizes his objectives. Even more, he is able to refuse help from the researcher indicating, once again, growing confidence with the issues surrounding the technology. Another issue of importance is Participant3's increasing concern that her students participate fully in the project:

*Participant1: One of our objectives in the course is to discuss and sensitize kids to environmental issues. And just taking data of weather it is more geography than ...*

*Participant3: I really can't work during the summer. This has been a very very busy year and I don't want to commit myself to work during the summer.*

*Researcher: Well, we can leave everything for the end of August because I'll be back the 29th.*

*Participant2: Or, we could do it today.*

*Researcher: Or, we could do it today, that's right. And send it over the...*

*Participant1: Well, I can write up, you know, my proposal and in an hour or two. I know what I want to do in regards to this environmental thing.*

*Participant3: And you know how the English program can be integrated into that?*

*Researcher: Well, you are here until Thursday. I could come back Tuesday or Wednesday and...*

*Participant1: I don't think there is any need to come back. Because Participant3 has agreed to do the editing and I can find the students who will ... I need technical help.*

*Participant3: And I would like the students who do the editing to see the other aspects, too. I mean, you know.*

*Participant1: Well, there's no problem with that.*

In this next section, Participant1 describes in greater detail his project to Participant2 and Participant3. His concern at this point is primarily on the need for technical support; he is comfortable with the conceptual aspects of the project and on how to use the technology. Note, as well, his emphasis on the interactiveness of the technology. Or, communicating with other students appears to be the primary motivational factor:

*Participant3: Are the kids excited about it? The kids who worked on it?*

*Participant1: Yeah, initially they were.*

*Researcher: Did they become bored with it?*

Here, he emphasizes the interactiveness, of ability to communicate, as the factor fostering enthusiasm:

*Participant1: Well, they were excited about the whole concept of collaborating with other kids...*

*Participant3: That's it!*

*Participant1: ... across the world. When the thing from Malaysia came in they were ecstatic about it. But the project was so simple, what we were doing was collecting data and sending it back that it was actually a boring activity.*

*Researcher: Did every school that participated send in the data?*

The need for technical support is stressed in the following passage:

*Participant1: Yeah, they did. We collated it and we sent it all back … of the results to everyone. Marcos showed us how to send* *the same data to multiple people all at once. Those are the types of technical things that I need support with. I couldn't have done that. And if Marcos wasn't around, we couldn't have done this project because there is no one who has the technical expertise.*

*Participant3: I think the kids will be excited about sending ideas, you know, English project, but the idea is wonderful.*

*Participant1: But knowing the constraints that the equipment puts on.*

*Participant3: But what are the constraints? How often did you use the computer?*

*Participant1: Everyday when my kids came into class for five minutes I told them to go and check what's on the electronic mail today. They would pick-up messages and ... it would take them about ten minutes.*

*Participant3: How many class of each class?*

*Participant1: It was just two students involved (Participant3: Right). If you have a whole class wanting to look?*

This next segment is of particular interest because it suggests the growing acceptance of the other teachers to Participant1's expertise. First, there is an admittance of ignorance on the part of Participant3. Second, most questions posed by the teachers are directed to Participant1 as opposed to the Researcher. And third, Participant1 takes this opportunity to formally invite Participant2, the computer teacher to participate:

*Participant3: I don't know. You tell me. I mean, I don't know anything about this...*

At the next passage, note Participant1's emphasis on manageability:

*Participant1: Well, four is manageable if that is all the number of students that are going to have to use the machine.*

*Participant3: See, I think one project should be done well rather than a few projects done superficially.*

Again, Participant1 explains his approach and the viability of it:

*Participant1: Well, that's why, for example, when I got into this I picked a very simple project (Participant3: Right) just to see how the mechanics of it would work. And I found that working with two students, they spent a lot of time on this stuff, small project, but really is a minor part of their day. They put a lot of time into that small activity knowing what else these youngsters have to do in the course of a school day. So it is not an easy technology to use at this stage. It takes something to learn extremely quickly, didn't they? And they are bright kids. If you have kids that don't pick-up things as quickly then you'll run into all sorts of...*

He then re-emphasizes the most feasible way to approach the project. Of importance is the leadership role he is able to assume and the secondary role taken by the researcher:

*Participant1: But, you know, I don't know how much you want to open this up. And I'm just saying from my experience you can't have a lot of kids using the machine.*

*Participant3: What would you suggest? Two from English? Four?*

*Researcher: What about four in two pairs?*

*Participant3: That's what I was thinking. Just two pairs.*

*Participant1: Because we have two machines…*

The researcher is then able to intervene and suggest a course of action that offers support and greater collaboration. Of particular interest is that Participant1 does not evidence surprise at the suggestion. Instead, he is able to add to it by inviting Participant2 to join the project:

*Researcher: It would be really interesting to have a support group of kids in the school that know a little bit of uploading and so on. The other kids could call on them if they have problems. I think that is where Participant2 would be the key to that.*

*Participant1: That's where I would love Participant2 to come in.*

*Participant3: What does … know? I know he is dying to get into this telnet and he lives in your classroom.*

*Participant1: He's here too.*

*Participant2: Well, I don't know all the things. I got a list of questions here today of the kind of nature I would like to know about.*

*Researcher: Well, Participant2, what I can do is help you create a technical project, almost, where your kids really become...*

*Participant2: I think it is important ... I have only one machine downstairs, I don't even have two, and I have my regular class to teach...*

*Participant1: Why? You couldn't send two kids? Well, you would have to be around to assist them, is that it?*

*Participant2: Yeah, I find that quite a bit, you have to be right there when they get stuck and they don't know what button to push.*

Participant2 then begins to question his role in the project and the level of support needed. The following exchange is significant because it indicates the level of knowledge and curiosity held by Participant2 and the need for him to become more acculturated to the technology. It also suggests a preoccupation by Participant2 concerning his lack of knowledge in using the technology compared to that of his students:

*Participant2: They just explore. It is like a new universe for them and they want to mess around, which is the same thing I do when I go and look at these menus and try to figure out what I can learn from here, and I get lost. It's kind of a, whatever you call* *it, a cyberspace or whatever, it is a very big place that you have to sort of find your way around in. And it takes a lot of time.*

*Participant1: It doesn't seem that we really have technical support.*

*Participant2: I think you are only going to use e-mail. I don't know what sort of technical support you really need.*

*Participant1: Well, things like taking, like, writing something on a wordprocessor, downloading it, into the e-mail, I don't have a clue as how to do that.*

In this following exchange, the teachers discuss how to use student knowledge in support of the project. The acceptance of student support for a technology they do not fully understand suggests an implicit growing awareness of the impact the technology is having on their roles in the classroom. It likewise indicates an ever present concern with the lack of technical support and instruction:

*Participant1: For my project, that is really what I have to know. We have to know how to type something on a wordprocessing, put it into e-mail and send it out. And we also have to have instructions for sending the mass mailing to all of the participants without having to send one to each person.*

*Participant3: And to receive it, you just have to call in?*

*Participant1: Yeah, to receive it ... it's like reading my mail. I see what people sent me (Participant3: Right), I either delete it or I send them a reply (Participant3: Right). And that I've learned how to do, it's quite simple. It's the other things that it would be nice if I have somebody who I could go to here in the school and say: We want to do this today. How can we do it?*

*Participant3: So the idea is to train some students who were really interested?*

*Participant1: That's what I thought computer science area could do.*

*Participant3: And once we have trained students we can expand.*

*Participant1: We need some resource people.*

*Participant3: Yeah.*

*Participant2: I have to learn it first. What are you looking at me for!*

*Participant3: (laughter)*

*Participant2: And what you are asking to do, some of it I can do.*

In the next segment, Participant1 explicitly argues for a project whose objective is to enhance learning; the project should not be about learning about the technology. Rather, the project should stress science and facilitate the learning task. In essence, he succeeds in describing the primary objective of any Internet or computer project: Enhancing the learning task through the use of technology. Note, too, the confidence of Participant1 in asking the Researcher for support. Basically, Participant1 is not asking if it can be done; rather, he is requesting a specific activity from the Researcher so as his project can come about:

*Participant1: But there are people who are very interested in the technical parts of this. You know, my agenda is to get my environment project done, as easily as I can. If the technology is not friendly enough to do it with minimum glitches, then it is almost counter productive. If there are too many aspects developing, the whole learning environment, process is in ... My bottom line is: I want them to learn about the environment.*

*Participant3: I think there is no end of projects, of interesting projects, that we could think of. It's really getting the technological help to implement these things.*

*Participant1: Again, I think what I'm proposing is modest enough so that even if there are problems there, they are easily solvable. And the project can go ahead and I'm involving a lot of students in it although not all of them will be on the machine. They will all feel that they are involved because they are contributing data that is going to be used.*

*Participant3: And it is an important part of the English program too, to learn this skill.*

*Participant1: I think if you could write me instructions for (Researcher: That's no problem. I have to do it for my class. It is no problem whatsoever). I can draft the project as it will go on the Internet. Another thing I've setup is, if you want your kids to reserve time on the Internet I setup a reservation list (Participant3: Oh, yeah). You can reserve for any period during the day or lunch or after school because I'm always here.*

*Participant3: So there are spots there if I could do that program, there are so spots that they could use.*

*Participant1: Yeah, I don't mind kids coming in here while I'm teaching. But I won't be able to come in to help them.*

*Participant3: Right. Well, that's the problem. As I said, working up the program is one thing, but teaching them how to use the Internet is the problem.*

The issue of cooperative learning is the next subject of discussion:

*Participant3: I see this as a great opportunity for cooperative learning too.*

*Participant2: It fits into the grade nine course more than anything else.*

*Participant3: I know, I know. But you know, it is ... some way to get some money too, Participant1.*

*Participant1: Yeah.*

*Participant3: I mean, you have been doing it for years. You are absolutely right. In Israel, they did this years and years ago.*

*Participant1: … teaching has always been this way.*

*Participant3: That's right.*

*Participant1: Before we worked in labs.*

*Participant3: That's right. Absolutely. Absolutely.*

*Participant1: The whole process of science is collaborative. Anyway.*

Finally, it is decided that a proposal requesting other schools to join will be written up. The idea was to have abstracts of environmental news collected by science students, which are then edited by English students and issued over the Internet in collaboration with other schools. The computer students would offer the support and instruction needed by the teachers or other students. In conclusion, Participant1 will write up the program, have it checked by the Researcher and then post it on SchoolNet and other forums.

*Researcher: So Participant1, you'll write up the project?*

*Participant1: I'll write up the project.*

*Researcher: Do you want to run it through me first or do you feel comfortable enough to send it through?*

*Participant1: I can run it by you first.*

And, in the concluding remarks, Participant1 stated:

*Participant1: Well, that's great ... I mean I'm learning as I navigate... I'm really excited about this project.*

A meeting was scheduled for the following week to review the project and Internet posting.

9.8.1. Follow up Meeting with Science teacher, Computer Teacher and English Teacher

While this next meeting raised the same issues discussed in previous meetings, it also brought other concerns to the fore. First, the teachers began to plan a workshop for the next school year to introduce other teachers and staff to the Internet. In this workshop they would discuss past experiences using the Internet and ongoing projects. That the teachers would invest time and resources to introduce the Internet to other teachers is reflective of their continuing acculturation to the technology and understanding of its impact. In fact, it could be argued that the acculturation to the technology and community by the three participants is complete and by their planned workshop, they are laying the groundwork to create a true Community of Learners in their school.

Second, the teachers planned for projects among themselves occasionally calling on the Researcher for help or clarification. Their confidence in their understanding of the technology allowed for them to plan projects that more closely met their objectives and teaching strategies. The Researcher was assigned the role of resource person or expert consultant and co-learner. And third, all three indicated that they wished for a more interactive project utilizing to greater benefit the potential of the technology.

For example, at the beginning of the meeting, Participant1 expresses the concern that the previous project relied too heavily on electronic mail and that he wished to examine more interactive applications:

*Participant1: The only thing that worries me, it's really a fancy way of sending mail. I mean I could have done the project that we did using regular mail. Right? We could have done it that way. I know the kids they seem to enjoy doing it this way, using the computer, I think they like the feedback that they got.*

*Researcher: I guess the question is what's the potential in this, right? In sending electronic mail.*

*Participant1 : Yeah. I drafted a proposal for this project for next year. But again, it is an e-mail project. I would like to see us expand more other aspects. The one I am particularly interested in seeing work perhaps is the working of it with experts.*

Perhaps even more surprising is the comment by Participant1 that the technology in the school can be used more optimally:

*Participant1: And we are, we are spending money on this facility and I would like to see it used more.*

At this point, Participant3 joins the conversation. Note how Participant1 is able to emphasize the above concerns:

*Participant1: This discussion progressed from the point that I raised the issue of electronic mail. E-mail is one aspect. It is really just a quick way of sending mail.*

*Participant2: One of its advantages is though that it is really quick. You can do things instead of sending it way and getting an answer back a week or so later. Yeah, it is quick.*

*Participant1: It is still only one aspect of the SchoolNet. And I'm a little uncomfortable using this resource which for the school is quite expensive (speaking of the telephone line to access SchoolNet and not SchoolNet itself) just for that.*

*Researcher: I agree.*

*Participant1: I would like it expanded into something else.*

In this next exchange, note the absence of the Researcher. Note also the implicit familiarity with the technology on the part of the teachers when discussing possible models for their projects:

*Participant1: I would like it expanded into something else.*

*Participant2: Even this thing where they ... different schools share the editing of a newspaper kind of thing. I think that is good to. So you can decide on people around the world.*

*Participant1: But it is still basically using e-mail.*

*Participant2: Yes, yes. I wasn't thinking of your science project. I was thinking of the one in Finland, actually.*

*Participant3: Is that a newsletter?*

*Participant2: That kind of thing.*

*Participant3: And different schools contributed different articles to it?*

*Participant2: Yeah.*

*Participant3: I like that.*

*Participant2: So, each turn, each school takes a turn being the editor.*

*Participant1: Can we have a copy of this?*

*Participant3: Each school takes a turn being the editor and as the editor it would be up to me to gather information from various schools? And send it out?*

*Participant2: Contributing schools would send stuff in.*

*Participant3: Right. And the kids would ... and things that are of interest to their school?*

*Participant2: Yeah, one of them was on school stuff and one of them was on world stuff.*

*Participant3: Right. So they have three different ... the international, the national, and maybe personal?*

*Participant2: No.*

*Participant3: Different categories of interest?*

*Participant2: I think there was a newsletter for school stuff. Just school stuff which I wonder if it would be useful for you to find out what is needed in a school somewhere in Manitoba. And the other one was world.*

*Participant3: Well, it may be interesting to have ...*

*Participant2: Political, social*

The teachers were also able to focus on their objectives for the project. For example, when the discussion appeared to go off on tangents, Participant1 reminded the others that:

*Participant1: The focus of this project is to find out what issues are of concern to local communities in different parts of the world. And hopefully we will see whether there are specific issues in one community that are very different from what we feel are important. You know, the focus is different. We you are going to look on the Internet ... they are global concerns and not local community concerns.*

The dialogue also reviews the merits of the project and the use of the Internet. Of importance is their implicit concern of how students may benefit from the technology and how those excluded from its use may also participate in the project:

*Participant3: Well, I have thirty in each grade ten. I wasn't thinking of doing this with grade eights. But I could involve a whole class doing the editing. That's not a problem. That's a skill and then take out two or four or whatever that can be matched up with the two you are working with so that they understand the whole procedure.*

*Participant1: Basically, what this involves is maybe two or three kids on the computer perhaps once-a-month. It's not a lot of kids.*

*Participant2: So there's not going to be a lot of learning about Internet.*

*Participant1: Not in this proposal.*

*(Everyone speaking at once)*

*Participant2: So it has got to be learning about something else.*

*Participant3: Do we have to have the same kids go to ...*

*Participant2: But it is just ... technology. You don't have to have everybody learn it how to use a movie projector.*

*Participant1: Well, that's my perspective. This to me is just another tool at the moment.*

*Participant2: So how can we use this tool, right?*

*Participant1: This is how I can use it. In the practical sense of my classes.*

Later, the teachers discuss the problem of acculturating other teachers in their school. That is, they begin to plan for the creation of a Community of Learners. They likewise discuss the questions raised concerning their investment of school resources in telephone lines. Of interest is their perspective that other teachers need acculturation to the technology. Note that there is little of no discussion concerning the abandonment of the technology. In this next section, the researcher inquires if the Teachers plan to make use of networking an integral component of the curriculum:

*Participant2: I wanted it to be part of the curriculum. I'm pretty flexible about that, but there are three other teachers that I have to convince that this is a good thing. And one of them has been on for a little while. But the other one has not been on at all and the department head hasn't been on at all. So, if people don't get on the system, they have no idea of what is going on, really. They are not even thinking about how they might use it.*

*Participant1: What is this?*

*Participant2: I was saying, if people don't get on the system, they can't have an idea of how it can be used. Can't see what other people are doing.*

*Participant1: This is a problem. There is pressure on me, I don't know if you are feeling it, but I've been told that they are* *spending $100 a month for these two phone lines (Participant3: Yeah), that's twelve hundred dollars a year, and they want this opened up to more people.*

Here, discussion begins on the possibility of presenting a seminar for other teachers at the school:

*Participant1: Yeah, in fact we are planning something for the end of September we have a professional day. We wanted just to introduce to any interested teachers SchoolNet.*

*Researcher: You could contact SchoolNet directly and ask them for a presentation. Or I would be able to come in and do it as well.*

*Participant1: Well, … said that he might do it as well.*

*Researcher: I would like to come to it. You might have more credibility since you are a teacher.*

*Participant1: I'm just trying to facilitate more use of these two machines.*

And later:

*Researcher: I'm not sure, but you may have been the first person to run a project in Quebec. I don't know anyone else who has used SchoolNet in Quebec.*

*Participant1: You know, frankly, I have to find someone who is enthusiastic. I'm beginning to wonder.*

*Participant2: Have they tried anything?*

*Participant1: No one has tried anything. People who have seen this, yeah, they say so what. You know, it is not user friendly as taking the CD-ROM popping it in.*

*Researcher: No, you are absolutely right.*

*Participant1: And that is the problem.*

*Researcher: It is the support, teaching, the lines are slow, equipment, it just goes on and on.*

Discussion then turned to the objective goals of the seminar. Of importance is the role that the teachers were willing to play. Participant1 would discuss his project and Participant2 would introduce the technology. The Researcher would present the educational perspective and significance of the technology. Still, the idea for the seminar was initiated by the teachers and planned by the teachers. The implicit enthusiasm is reflective of their acculturation and belief in the benefits of the technology:

*Participant1: So, my big thing now is getting support. The other thing is this workshop in September. Would you be willing to give it?*

*Researcher: Yeah. I think it would be a good idea to have Participant2 participate.*

*Participant1: Yeah.*

*Researcher: Because I think it would bring it a lot of credibility. Bringing in an outsider to talk about it, especially since I'm not a teacher, you know, they will comment...*

*Participant1: Well, the three of us can do it. I mean, I can talk about what I did last year and what I am doing this year. Participant2 can talk about what you are doing. This is the ...*

*Researcher: Do you want technical explanations?*

*Participant1: Not too technical. It turns people off. You will be talking to teachers that are not computer literate. I would like to see this as ... I would love to see some social studies people involved. ... That's another problem. Many of our subjects are done in French.*

While discussing the coming seminar, the issue of support is raised. According to the teachers, support was perhaps the most important component responsible for the success of the project. However, the Researcher can state that his support was minimal, and was restricted to a few sessions showing the teachers how the Internet works. What the teachers refer to as support, at this point during the project, is vastly different from the technical immediate support most would imagine. Essentially, support appears to mean acculturation to the technology and access to information concerning a specific problem with the technology. In this following section, the above is implicit in their exchange:

*Participant1: I'm the kind of person that jumps in and does things. And I don't wait for ... I mean there's some people who will want to know all of this. But most people aren't like that. They want reassurance. They don't even want to think about it. And let me tell you, I would have been in a lot of trouble jumping in the way I did without you giving me the support that you did.*

*Participant2: Well, that's it. You know, I don't mind jumping in if I know that hanging over my shoulder there's someone who can help. That's not a problem. As far as ideas are concerned, there's no shortage of ideas, things that we would like to do, or reasons as to why, I mean I would like to communicate with people all over the world, and there are any number of interesting things going on. That's the easiest thing to find.*

By the end of the meeting, it was decided that students from Participant2's computer classes would offer the technical support and students from Participant3's English class would offer the editing support. Students from Participant1's course would search for articles in newspapers dealing with local environmental issues and share them with other students in remote high-schools via the Internet. In the following exchange, note the teachers' implicit recognition that the technology and design of the project is able to foster collaborative learning activities:

*Researcher: I really like the idea of the collaboration between the three of you.*

*Participant3: I like that too.*

*Researcher: You are English, and Participant2 has the kids as experts...*

*Participant3: Yeah, I like that.*

*Researcher: I mean, it couldn't be more innovative ... because the technology itself is not important. It's pushing buttons. What is important is being able to do collaborative work like this. With people outside or in your own school.*

*Participant1: That's what I find.*

*Participant2: Collaborative, I like the collaborative part. It is a cooperative learning type of thing.*

Participant3: Yeah

9.8.2. Last Meeting with the Science (Participant1), Computer (Participant2) and English Teacher (Participant3).

When analyzing the data of this last meeting, the first thing that appears striking is the emphasis on using the technology for collaborative learning. Throughout the meeting, the teachers speak repeatedly of collaborative learning as a positive outcome of implementing the project. As well, of interest is the attempt by the teachers to collaborate among themselves in the design, implementation and administration of the project. All three agree that they can benefit from close collaboration in the use of the technology. Their implicit understanding that the technology can foster collaborative learning supports parallels the findings of the research on use of the Internet by local or remote groups. Arguably, then, a community of learners had been created within this small group.

The second noteworthy aspect of the meeting is the request by the English teacher, the least knowledgeable of the three for full participation in the implementation of the project. Also important is her concern that her students, who would act as editors in the creation of the electronic environmental newsletter, share fully in the learning and use of the technology.

Third, the teachers appear to understand the mechanics required to implement an Internet-based project. Most of the questions directed at the researcher are conceptual; they require knowledge on variables that will offer them and their students the most benefit from using the technology. They do not need assistance on how to administer the project and appear ready to plan the stages themselves with little or no help from the researcher. However, all three teachers were aware of the needed technical support required for the successful implementation of an Internet project, especially one that promised to be more challenging than the previous one.

Finally, the teachers all voiced a desire to introduce the technology to their colleagues in the school. This would be done both individually and through the presentation of a seminar. The researcher was requested to participate along with teachers who would describe their experiences in using the Internet. This indicates an acceptance of technology more sophisticated than that required to implement a project.

In the beginning of the meeting, Participant1 introduces the idea of collaborative learning and how to integrate the concept with the project:

*Participant1: There's another thing in the works. Our school board has targeted a lot of money for cooperative learning.*

*Researcher: Great.*

*Participant1: And, what I am contemplating here is sort of cooperative project where we are working with the English department on the editing aspect of it, the students are doing oral seminars on the issues that are drawn up in the newsletter. So, we are hoping that we can get some funding and maybe hire some kind of resource person.*

The Researcher reinforces the idea by stating that the emphasis on collaboration between the three teachers is a particularly original component of the project:

*Researcher: Very good. I think this will work fine. What I think the strength in this is the cooperation between you, Participant2 and Participant3. There's ... for the English, computer science...*

*Participant1: Yeah, ... multidisciplinary. No, it is a good start and a little more advanced and ambitious than what we did last year. We are moving in the direction.*

Once again, the researcher reinforces the idea of cooperation among the teachers and the students. However, implicit in the teachers' response to his encouragement is an understanding of the technology tempered with a more practical view of what is possible given the existing resources. This attitude indicates a notable progression in the learning and conceptualization of the technology and its potential.

*Researcher: You know, I'm really impressed by the fact that you decided to make a collaborative project between three different disciplines. I never seen this before. I find it really innovative. That's the reason my supervisor wanted to come. I think you might really be embarking on something quite original.*

*Participant1: I think it is a very modest activity.*

*Researcher: It is curious. You are saying that because you have the experience from the previous project. So you know that there is no magic to it. But if you go to other schools that never touched a computer and telecommunications, to them this will seem* *far more advanced than it really is. And I guess that is what learning is all about. It isn't all that mysterious if you know.*

*Participant1: I suppose I'm running it down. I think it is a very worthwhile pedagogical exercise. From my perspective as a biologist, I think the editing skills you students will be having...*

Next, throughout the meeting Participant3 insists on full participation by her students in the use of the technology. Participant3 also insists on acquiring knowledge about networking and the Internet. There are several reasons why this should be noted. First, the teacher believes that by more fully understanding the mechanics of the technology, she will be able to ensure full participation by her students. Second, implicit in her statements, and in statements made to the researcher at a later date, is the belief that once she acquires knowledge she will be able to impose more of her perspectives on the use of the technology. And last, she wants to be assured that her students are not excluded from the benefits of the technology.

For example, at the beginning of the meeting, she states that:

*Participant3: What I like about it is that I think it's, I don't like working in isolation as a department and I think that this is the way we can start doing things.*

And later on:

*Participant3: I'm in another reality when you talk about that (Laughter). But I want the kids who are doing the editing to also hook into the terminology and see this working too. I mean, I wouldn't like to see them as some satellite out there that just sending in corrected versions.*

Again, while the others are discussing an entirely different topic, Participant3 brings up the question of participation and learning once again:

*Participant3: See I would like the kids to see the whole picture. Because one doesn't like to be doing that ... (Participant1: I can understand that) and if we can show them that a demonstration of something I think they would understand it more.*

*Participant1: Okay, if I don't feel ...*

Throughout the meeting, the above points are repeatedly emphasized:

*Participant3: When you say it would be nice if more people could get involved, there are a lot of teachers like me and they would like to know, probably, how and other...*

*Participant3: I would like to have the kids so that they can see ...*

*Participant3: Right. the thing is I would want the students that I chose to be in here from the beginning. Because I want, I think it is important for them to be, to see the whole…*

And at the end of the meeting:

*Participant2: No, I want them here too because I want them to see that they are part of the whole program.*

*Researcher: I think Participant3 is right on that. I think so too.*

*Participant2: I mean, I'm going to be here too. And I hope to learn something... I don't want them to work in isolation.*

Next, the question of the workshop came up. The objective was to introduce the technology to other teachers in the school and get them to consider participating in a project. The teachers were planning to participate and requested the researcher's participation as well. Again, of importance is their implicit and explicit acceptance of the technology and it positive impact on learning and teaching.

For example, If the initial stages of planning the workshop, the first concern is to make sure the presentations are relevant to the teachers and their interests:

*Participant1: So we have an hour and a half, [Participant2], for this project, the workshop.*

*Participant3: Yeah. Yes, on that day.*

*Participant2: It's nine to ten thirty?*

*Participant1: It's nine to ten thirty. A half-hour break. And then XX.*

*Participant2: And then XX. I knew it was a workshop but I forgot that it was ...*

*Participant1: So Marcos will give an overview and what will you do?*

*Participant3: I haven't thought about it yet. Talk about why I think our teachers can be. The facilities we can offer.*

*Participant2: And how you can make it useful and friendly for people like me.*

*Participant1: That's the big problem. It is not ...*

*Participant2: I know. If the instructors are friendly.*

And then again, an emphasis on making the workshop relevant and easy to understand. Note also that the researcher hardly intervenes in the planning of the workshop and offers but a brief suggestion:

*Participant3: I could just have said: forget it. What are you going to do? Just like a pep talk, an overview (Speaking about the forthcoming workshop)...*

This brief but important intervention by the researcher helps to set the objectives of the seminar; rather than being merely technically informative, the seminar should also explain the educational aspects of the technology and how it can impact on teaching.  That is, why teachers should concern themselves with it:

*Researcher: An overview of why teachers should get involved.*

*Participant3: Why teachers should get involved?*

*Researcher: Or their students as well.*

*Participant1: Are you going to need this SchoolNet ...*

*Researcher: An overhead and a computer would be nice if we could have the same setup that we had in the library.*

Note that the teachers were quick to pick up on the researchers suggestion that the workshop should emphasize teacher participation:

*Participant2: When you say it would be nice if more people could get involved, there are a lot of teachers like me and they would like to know, probably, how and other...*

*Participant1: Well that is where I come in to show them how a specific concrete project (Participant2: Right) The bottom line is the support (Participant2: That's right).*

*Participant2: Well, the only thing I would say would be to tell them what I was doing. Your students are going to collect the articles, and now, select the ones they want, and they will send them on to us. And then the total, I think, that it is important that all of the bits and pieces, like the kids who are finding the articles, and the kids who are this and the kids who are doing the abstracts come together every once in a while and see what the whole picture is.*

*Participant1: So maybe you can speak about the multidisciplinary aspects of it. I'll describe the project, why I feel ... you want to see this as an instance of collaboration.*

9.8.3. Conclusion of Meetings

The workshop was attended by about 25% of the teachers in the school. The Researcher presented a brief introduction to the history and evolution of the Internet. Naturally, emphasis was put on the potential educational uses of the technology. The Computer Teacher (Participant2) gave an introduction on his use of technology, and why he thought it important for others to become involved and a description of on-going projects. The Science Teacher (Participant1) offered a description of his participation in the first project and why he felt convinced others should become involved as well. A review of the planned collaborative project was presented as well.

A guide to the Internet was created by the three teachers for distribution to their colleagues. The guide included general information on the Internet, information available online, information on ongoing projects and information on SchoolNet. The guide is reflective of the progress made by the three teachers given that they were largely ignorant of the technology but a few months ago.

Participation in the workshop was the last direct intervention by the researcher. The teachers were sufficiently acculturated to the technology and sufficiently aware of its potential and problems that his presence was not really needed. From an initial modest project and subsequent project, the school was able to implement other original projects and was one of the first schools in the Montreal area to successfully introduce and use the Internet in many of their classrooms. In fact, the school offered seminars to other teachers from other schools and school boards.

The interaction between the teachers and researchers suggests that acculturation to the technology is perhaps more important that technical knowledge. However, access to technical support is essential to the success of any Internet-based classroom project. Also, teachers need interaction among themselves to discuss the technology and its impact. This is a fundamental component of the acculturation process necessary for teachers to feel comfortable with the technology. And last, the interaction and communication between the teachers and researcher/technical support, must be on-going and predicated on their needs and wants. That is, in keeping with the participatory design approach, they must be full partners in the introduction, design and implementation of any project or technology.

The problem, then, was how to offer the conceptual acculturation and technical knowledge to teachers so as they would be able to independently implement a network-based project? That is, how to create an environment where collaboration, interaction and communication are maximized so as to allow the acculturation needed to use the technology. Or, how to create an environment that fosters the development of a Community of Learners? And even more, this acculturation had to be in real-time, on-going and personalized to the level of each participant. Lastly, and perhaps most difficult, how to introduce this interactive and collaborative introductory model to a large heterogeneous group?

# CHAPTER 10: THE DESIGN AND IMPLEMENTATION OF AN INTERNET-BASED COURSE

The data from this project suggest that, as appreciation of the Internet and of the benefits of educational networking increases among teachers, the need for acculturation to the Internet becomes essential. Indeed, the data suggest that the need for acculturation is as important to the successful introduction of the Internet as is adequate technical support. Also, the rate of technological change does not eliminate the need for acculturation. Or, in other words:

> It is becoming increasingly clear that technology in and of itself, does not directly change teaching or learning. Rather, the critical element is how technology is

incorporated into instruction (United States. Office of Technology Assessment, 1995,).

The above perspective is also present in a literature review completed for SchoolNet (Grégoire, Bracewell & Laferrière, 1996). Implicit in their review is the recognition that the introduction and use of the technology are the major agents of change:

> The technology can be an important component to bring about new and better kinds of learning; but as with all tools, effective use of the technology is embedded within practices and activities that realize its functionality for specific purposes and situations and computer-based learning technologies has been the general driving force motivating the recent research reviewed below (1996, p. 6).

It is possible, however, to take the above perspective one step further by asking how does a teacher gain the knowledge necessary to assess the functionality for specific purposes and situations of new computer and network tools? It is argued that the knowledge to undertake review and assessment of these new tools arises from the interaction possible when using network technology. And the interaction results in acculturation in the use of these new tools. Acculturation is best exemplified through what Brown and Campione call Fostering Communities of Learning (1996). Thus teachers are faced with two obstacles when attempting to use networking technology: The first is the lack of technical knowledge and access to instructional support about an environment undergoing constant and rapid change and the second is the need to have adequate introduction to the culture of the Internet.

The data from this project suggest that the above obstacles can be met through the implementation of an Internet-based course (for a description of the course created for this project see Appendix B). The project also demonstrated that the success of the course rests on the interactive and communicative protocols of the Internet, namely e-mail and, to a lesser degree, Internet Relay Chat (or chat rooms). That is, from this design, it became apparent to the instructors that the attractiveness and success of the course was the result of the interaction arising from the use of electronic mail, either between students, among students, between professor and students or student. This finding parallels many of the claims made for the use of electronic mail as a means to promote classroom discussion and interaction. That is, discourse, stimulated by the active exchange and reciprocity of dialogue (Brown & Campione, 1996, p. 305), became the most dynamic and popular aspect of the course.

For example, as a result of an Internet project sponsored by Virginia Polytechnic Institute and State University, the town of Blacksburg, Virginia is per capita one of the most wired places in the world (Chandrasekaran, 1997, p. A1). Documentation on the

Blacksburg Electronic Village (BEV) estimates that 62% of Blacksburg's 36,000 citizens (about 22,000) use Internet e-mail. Statistics based on IP addresses show roughly 18,000 citizens have access to the BEV and the Internet. Indeed, Blacksburg is unique because of the proportion of residents using the Internet.

Researchers, however, found that email is the most widely used application, surpassing interactive systems based on hypertext transfer protocol. (Kavanaugh and Patterson, 1997, p. 1). Or, as Andrew Cohill, assistant professor at VPI and who administers the project, put it: "It may sound silly, but e-mail is the thing everyone here uses the most. People fundamentally see the Internet as a two-way communication medium, not mindless entertainment" (Cohill cited in Chandrasekaran, 1997, p. A1). Given the substantial body of research resulting from the Blacksburg Electronic Village Project [URL: http://www.bev.net/project/research/), the above statement is surprising.

Of particular interest to this study, however, is the belief that the Blacksburg Electronic Village project may be able to build "social networks and information exchange needed to achieve collective action" (Kavanaugh & Patterson, 1996, p. 20). Furthermore, "Internet users in the community network of Blacksburg Electronic Village report that they have become equally or more involved in issues that interest them" (p. 21).

That social involvement arose from using electronic mail can support the assertion that it is the interactive potential of the technology that is significant; group participation and involvement via electronic mail is but a short step way from group learning and collaboration via the same medium.

Similar to the findings of the Blacksburg Electronic Village, creation of and acculturation to an electronic communicative environment is the primary focus of the course. Teachers are able to interactively learn the technology, acculturate themselves to the environment and create communities of learning to sustain their interest and knowledge in an environment that undergoes constant and rapid change.

Finally, the project also demonstrated that teachers enrolled in the course using networking technology not sophisticated by current standards faced the same problems as teachers using current and more sophisticated technologies. In other words, regardless of the technology used, the issues and processes of integrating networking technologies will be similar. In this manner, the questions of how to design effective professional development environments to acculturate teachers and create communities of learning and how to create large-scale professional development programs are met.

# CONCLUSION

As gigabyte K-12 networks continue to grow, and governments invest in educational technologies, educators will be faced with increasing demands for integration of Internet/network resources and services with traditional classroom activities. With the advent of the NREN/NII, CANARIE and vBNS (very High Speed Backbone Network Service) networks, it is safe to assume that demands will increase significantly in the near future (see Appendix A for a description of vBNS). Indeed, the ever growing number of school children linked to local area networks and the Internet presages the direction of the above trend.

Given the above, it is curious that researchers appear to be disinterested in the process of introducing and establishing Internet-based K-12 projects. Moreover, it is puzzling that only recently has the interactive and communicative potential of the technology come under scrutiny when introducing new technologies. Granted, there is research supporting the use of network activities in the classroom. Nevertheless, there exists a serious need for research concerned with the process of introducing, training, and establishing such projects. There is also a serious need for greater examination of the optimal use of the communicative potential of the technology to create the cognitive dissonance and social interaction found in real classrooms.

Furthermore, the collaborative nature of the Internet invites a participatory approach where users of the system have say in the design and implementation of new procedures and technology. Participatory design likewise allows for a more humanistic approach to the introduction of the technology. Teachers and students are accorded the means to understand, implement and use a technology that may influence significantly their learning and teaching. In this manner, many of the pitfalls, obstacles, and misunderstandings normally found when introducing new technologies may be avoided. A participatory design approach, therefore, appears the best suited when introducing and integrating a technology that radically changes the relationship between student and teacher, teacher and teacher and teacher and researcher. Or, in other words, the interactive and communicative potential of the technology alters the hierarchies of power and control

This project demonstrated that the communicative and interactive potential of networking technologies offers the means to integrate effectively collaborative learning techniques with networking activities. Indeed, this project demonstrates that the ability to communicate is the most valuable component of the technology allowing for structured collaborative activities with local and remote participants. These activities further benefit from contextualization of the task, an audience and, if needed, mentorship or teleapprenticeship modes of learning.

The project also demonstrated that it is not the technology per se that affects the activity, but rather, the possible interaction arising from use of the technology. And interaction results in acculturation and understanding by teachers allowing them to better assess the technology and how it should be utilized. The data from this project indicate that teachers profit from on-going support and instruction and real-time interaction through the effective use of the communicative potential in networking technologies.

Finally, it was shown that large-scale, on-going instruction about networking technology that is personalized and relevant to each individual teacher can be created and implemented using networking technologies. In this project, interactive instruction, based on networking technologies was designed to meet these needs. Moreover, electronic mail, perhaps the most widely available Internet protocol, offered instructors and teachers the needed interaction and contextualization for acculturation and gaining of knowledge. Naturally, this means that effective on-going instruction aimed at fostering acculturation to the technology can be implemented with appropriate technologies that are basic and simple to learn.

It would be interesting to carry out further research on the most effective electronic communicative strategies. For example, would a story-telling approach, as advocated by Roger Schank, be more effective in leading the student to discovering the correct answer and creating the environment for greater acculturation? How effective is student to student interaction, especially interaction that a teacher cannot track? And, lastly, can real-time video increase the possibility of creating more acculturation and thereby further promote the environment needed for learning to occur?

In conclusion, this project has gained better insight on: How to integrate and introduce new technologies in the classroom; how to integrate traditional collaborative learning techniques with gigabyte networking activities; how to accord parent, teachers, and students a say in the design and implementation of new technologies; and how to foster greater use of the communicative potential of the Internet. It is argued that, because of the exponential growth of K-12 network based classroom activities, it is necessary to study the process leading to the implementation and establishment of those activities.

## ORIGINAL CONTRIBUTIONS TO RESEARCH

The importance and significance of this work is its recognition for the need of a teacher and student centered approach when introducing networking technologies in the classroom. Indeed, the success of the project was dependent on: The use of participatory design to foster acculturation to new networking technologies and to accord users of the technology a say in its implementation and use, creation of an electronic community of learning for the development of life-long learning opportunities, and communicating knowledge about an ephemeral, dynamic and changing environment. An electronic community of learning, then, is the vehicle to introduce the Internet and its use in classrooms to school principals and teachers.

This research also demonstrated the need for programs to introduce new technologies in the classroom. Although most Canadian and U.S. schools are now connected to wide area networks, and benefit from new network technologies and software, there is a scarcity of research on the process to introduce and integrate these new systems. This situation can create significant obstacles when introducing networking technologies in schools.

Also of importance is the project's recognition for the creation of electronic communities of learning to sustain interest in and understanding of new networking technologies.

These technologies change with astonishing speed, creating the need for on-going learning and instruction. Furthermore, electronic communities of learning foster acculturation to networking technologies allowing for personal interaction, cognitive dissonance, clash of ideas and the sharing of expertise. In addition, these communities are sustained by a host of new networking protocols. Networking protocols, however, that allow users to communicate are among the most important since they foster acculturation to the technology and assist in the creation of these communities.

NOTES

1. Networks logically connected are not physically connected; their links are the result of hardware that can create transparent connections among them.

2. Below, is a search using the keyword Internet conducted on the McGill University Peruse Eric database system on July 27, 1998:

| | | |
|---|---|---|
| 1 | internet.tw. | 2721 |
| 2 | limit 1 to (yr=1988 or yr=1989 or yr=1990 or yr=1991) | 94 |
| 3 | limit 1 to yr=1992 | 89 |
| 4 | limit 1 to yr=1993 | 141 |
| 5 | limit 1 to yr=1994 | 317 |
| 6 | limit 1 to yr=1995 | 586 |
| 7 | limit 1 to yr=1996 | 780 |
| 8 | limit 1 to yr=1997 | 614 |

3. *Request for Comments*, initiated in 1969, are electronic working documents on Internet applications and use ranging from casual ideas to technical specifications. They have become the de-facto method of documenting the Internet's standards, proposed standards, and ideas.

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# APPENDIX A

## A.1. The Development of High-Speed Networks and their Impact on Education

The growth of the present day Internet, a worldwide network of networks, has been explosive: Early growth estimates using computer host address records ranged from 9% to 15% a month (Lottor, 1993), although by summer 1997 Internet host level growth become linear at 52% per year (Kuny, 1997). Estimates on the number of users linked to the Internet continue to grow, although because of unlimited multi-user computer and network or application gateways, it has become impossible to give an accurate estimate of the total number of end users. It is safe to assume that there are perhaps hundreds of millions of end users accessing the Internet.

Also indicative of the Internet's phenomenal growth is the increasing heterogeneity of the user population. Whereas but ten years ago the Internet was used exclusively by the research, government, and academic communities, today its user base includes school children, business persons, and the public. For example, it is estimated that over 600,000 school children in the United States used the Internet to supplement their curricular activities during the 1991-1992 school year (Itzkan, 1992, p. 1).

By 1996, 65% of U.S. public schools had access to the Internet, a net gain of 15% over the last two years (United

States. National Center for Education Statistics, 1997, p. 1). By 1997, 78% of all U.S. public schools were connected to the Internet (United States. National Center for Education Statistics, 1998, p. 1). The 1997 figure, however, is misleading: While the vast majority of schools have connectivity, access to the Internet is present in but 27% of classrooms.

It is the recentness of the Internet that makes its growth appear astonishing. McGill University gained Internet connectivity sometime in late 1989. Its general student population had full access only in 1991. The literature on the Internet also follows this pattern. Prior to 1989, articles on the Internet were mostly technical and of interest to a limited audience. Today, a cursory search for monographs and periodical articles will retrieve a wealth of information directed at a far less technically oriented audience.

For instance, at the time of publication of the *Internet Companion: A Beginner's Guide to Global Networking* by LaQuey and Ryer, there were only three books available on the Internet, their work being the only trade edition (LaQuey, personal communication, January 3, 1994). At present, there exists a wide variety of titles and magazines devoted to the Internet. Moreover, when attempting to publish the work, LaQuey and Ryer received mostly negative replies from publishers. Sales of the work, however, far surpassed Addison-Wesley's expectations; the

*Internet Companion* enjoyed brisk sales for most of 1994 (LaQuey, personal communication, January 3, 1994).

These developments have placed significant pressures on national policy makers to upgrade existing networks by developing and implementing high-speed telecommunication networks. Indeed, every major industrial nation has plans to upgrade its telecommunication networks and significantly increase its user population. Developing countries, in times of scarce physical and human resources, are also upgrading their telecommunication infrastructure. It is not surprising to find, therefore, the private sector forcefully arguing for its increased participation in the development and creation of these new networks.

A.1.1. Background

The Internet was originally conceived as an experimental network to support research undertaken by the United States Department of Defense and its contractors. The project was implemented under the sponsorship of the Department of Defense (DOD), Advanced Research Projects Agency (ARPA). ARPANET, the precursor of the Internet, was designed to provide interactive communication among computers through the use of remote login, transferring of files and resources, and electronic mail.

It is interesting to note that although electronic mail is currently one of the most widely used Internet protocols, it was implemented as an afterthought within a couple of years after the development of other protocols, namely telnet (an Internet protocol that allows users to operate interactively a remote computer) and file transfer protocol (FTP, whereby a user is able to send or retrieve files from a remote computer to a host computer). Two researchers at Bolt, Beranek, and Newman, developed the protocols necessary for electronic mail over the ARPANET because they thought it useful to send messages over the network to each other.

Today, given the advent of HyperText Transfer Protocol (http) and the many flavours of HyterText Markup language (html), many of the older protocols are becoming obsolete. Hypertext Transfer Protocol is able to integrate many of the earlier protocols eliminating the need to learn their archaic and difficult commands. Indeed, with the exception of protocols governing the use of electronic mail, http has become the most widely used protocol by all categories of end users.

During the development of ARPANET in 1969, researchers had to contend with two primary problems: First, because most host computers operated autonomously, their software had to be reformatted to allow for remote access and interaction, and second, a method had to be found to permit access from general-purpose computing centres to more specialized computers. Accordingly, ARPANET, the first "packet-switched, store-and-forward, host-to-host digital network of computers," was born

(Lynch & Rose, p. 4, 1993). Only four computer hosts were initially interconnected.

Packet switching was a concept originated in 1964 by Paul Baran of the Rand Corporation. In packet-switching networks, each file is broken into packets with each packet assigned a unique address. During transmission, individual packets have no pre-determined route; each packet will be sent according to the most efficient, and possibly different, route possible (Hayes, 1997, p. 214). On their arrival, the packets are reassembled into their proper sequence. By 1971, the ARPANET had 23 host computers increasing to 111 in 1977 (Hart, Reed, & Bar, 1992). The first public demonstration of the ARPANET took place at the International Conference on Computer Communications in October 1972.

By the mid-seventies, other networking technologies based on ethernet or packet radio were being developed. A need arose to interconnect different networks based on different technologies while making the interconnectedness appear seamless and transparent. In essence, the objective was to create a technology that would interconnect autonomous networks functioning under different standards into one virtual network. These technologies are called protocols, and networks interconnected via these protocols comprise the present day Internet.

The initial protocol was called, naturally, Internet Protocol (IP). Again, the motivation for implementing more flexible and advanced protocols came from the Defense Advanced Research Projects Agency (DARPA), who hired one of the principal architects of the ARPANET, R.E. Kahn, to create a protocol that could support "...further applications of packet switching in different media and the problem of integrating these different manifestations of packet switching into a coherent whole for military applications" (Lynch & Rose, 1993, p. 80).

Basically, IP provides for the transmission of datagrams from a host computer to a remote computer through different gateways and, when needed, networks. Again, every packet has an address and is re-assembled with other packets once they reach their destination. IP, however, could not supply the reliability required from researchers at DOD; packets were lost or sent multiple times. For that reason, an additional protocol was created: Transmission Control Protocol (TCP). Transmission Control Protocol assures that packets are not lost by retransmitting the data until it arrives at its destination and by detecting and destroying duplicate packets. Internet Protocol and TCP and a suite of other protocols are usually called TCP/IP.

The first experimental network functioning directly under TCP/IP was developed in 1977. In 1978, TCP/IP was declared the preferred Internet protocol suite (Lynch & Rose, 1993, p. 10).

By 1982, the Defense Communications Agency, which had taken over administration from DARPA, mandated that all computer hosts connected to the Internet had to function under the TCP/IP protocol suite by January 1, 1983, the day usually cited when speaking about the advent of the modern day Internet.

As a result of DARPA's funding of Berkeley Unix, it was easy to incorporate TCP/IP into the UNIX kernel. Another decision to make that version of UNIX freely available to all computing sites running under UNIX further assured the expansion of the TCP/IP suite. Today, all UNIX versions contain TCP/IP in their kernel. Because of the ubiquity of TCP/IP, other manufacturers such as DEC or IBM also support TCP/IP interconnection services. In fact, even common desktop clients such as Windows 95 and Windows NT now have TCP/IP tightly integrated with their code.

Increasing concerns over security, caused the DOD in 1983 to split military applications from the ARPANET. This new network was called MILNET. ARPANET continued to support research and development of most non-military applications. Gateways were built to offer connection between the two networks. MILNET was composed of sixty computer nodes while ARPANET retained forty.

Parallel to these events, the National Science Foundation (NSF) of the United States received approval from Congress to create five supercomputing centres that were completed in 1985-86. Building these centers entailed great expenses, making it untenable to build centers at each research institution. To allow researchers access to these computing resources, the NSF decided to create networks linking the centers to remote users (Krol, 1992, p.12).

At first, it was thought that the new NSF network could be built on the back of the ARPANET. However, because of delays arising from acquisition procedures in the DOD, the NSF decided to build the network independently from DARPA (Hart, Reed, & Bar, 1993, p. 672; Krol, 1992, p. 12). In 1988, a *Request for Proposal* to build the network was awarded to three companies: Merit Inc., IBM, and MCI. By the middle of 1988, the new backbone was established.

Similar to the ARPANET, the NSF network decided to use the TCP/IP suite of protocols. Their decision was based on the belief that the new Open Systems Interconnections (OSI) protocols were not fully reliable. Because of the higher telecommunication lines of the new NSF backbone, T1 (1.5 Mbps) versus the ARPANET's 56 kpbs, the decision was made by the DOD to abolish the ARPANET; the network could not meet the demands made upon it (Lynch & Rose, 1993, p. 12). In other words, it ceded its place to the NSF backbone, which with other networks from NASA and the Department of Energy, became the de-facto Internet. By 1989, 200 universities and 516 networks were interconnected (Hart, Reed, & Bar, 1993, p. 673).

In 1995, MCI was awarded a contract to develop a new high-speed network based on the lineage of the NSFNet. This fostered the development of vBNS (very High Speed Backbone Network Service) operating at OC-3 vBNS (a speed of 155.52 Mbps). Eventually, speeds will reach 2.5 gigabits per second, allowing for the transmission of huge quantities of video, voice and data. The OC-3 vBNS network was fully brought online in 1997 giving researchers unprecedented access to high-speed networking services.

Today, MCI claims to possess the fastest telecommunication backbone in the world, operating at OC-12 (622 Mbps). Its packet-switched network rides atop of a new network based on ATM (Asynchronous Transmission Mode) which in turn rides atop a SONET (Synchronous Optical Network) network. However, the foundation of Internet traffic, the IP (Internet Protocol) cannot take advantage of these higher speeds.

On May 20, 1997, U.S. Vice President Albert Gore announced that the National Science Foundation awarded approximately 12 million in grants to 35 research institutions and universities to connect them to vBNS. With these grants, a total of 64 research institutions will have vBNS connections (United States. White House, 1997, p. 1). The above grants are a component of a project of much greater scope called the Next Generation Internet (Ngi) which will, among many things, "demonstrate new applications in areas such as distance education, telemedicine, national security and collaboratories" (1997, p. 1). This in turn will allow to "connect all of our children to the same universe of knowledge" (Gore cited in United States. White House, 1997, p. 1).

The establishment of high-speed networks based on the TCP/IP protocol suite by most of the major Canadian Universities in 1984, marks the beginning of the development of the Canadian component of the Internet (Bjerring, 1992). Interconnections among these new networks and the new NSF network, or Internet, became a priority (Bjerring, 1992). The development of regional or provincial networks, also based on the TCP/IP suite, advanced at a slower pace; by 1988 only three provinces had fully operational networks: British Columbia (BCnet), New Brunswick (NBnet), and Ontario (ONet). Quebec's regional network, le Réseau interordinateurs scientifique québécois (RISQ), was established in 1989 and is administered by the Centre de recherche informatique de Montréal.

Establishing interconnections among regional networks became an even more urgent priority. The development of a national high-speed telecommunication backbone that would interconnect all regional networks and offer gateways to the NSF network was given impetus as a result of a partial subsidy given by the National Research Council (NRC). This resulted in the creation of CA*net

Networking Inc. in 1990, which had the responsibility to oversee and administer Canada's telecommunication backbone (Cleveland, 1992). Until March 31, 1997,CA*net, therefore, acted as Canada's information highway and offered its users access to the world wide Internet. On that date, Bell Advanced Communications (BAC) took over administration of the Canadian Internet transit service backbone.

### A.1.2. The Development of National High-Speed Networks

The phenomenal growth of national high-speed networks comprising the Internet, has prompted policy makers to examine the impact that this development has and may have on research, industry, and education. In the United States, former Congressman and current Vice-President Albert Gore, has been one of the main advocates in efforts to upgrade existing networks. In fact, current projects in the United States can be traced directly to legislation tabled by Gore during his tenure as Senator. Gore's advocacy of the need for high-speed networks stems from the belief that advances in telecommunications are essential for a nation to preserve and secure its economic competitiveness in the international marketplace (United States, Office of Science and Technology Policy, Director, 1992; United States, Congress, Senate, 1991). His initiative on and justification for high-speed networks and computing has been closely watched and followed by other nations, particularly Japan and those of the European Community.

The Japanese Universities' Network (JUNET) is the major public high-speed network in Japan. Its primary objective is to promote greater resource sharing and communication among researchers in Japan and elsewhere. It also supports a parallel experimental network called SIGMA that was conceived as a testbed for new technologies and distributed processing research (Canadian Network for the Advancement of Research, Industry, and Education Business Plan Working Group, 1992, Appendix A, p. xii). Interconnections to other national networks in North America and Europe are supported via JUNET.

Another Japanese initiative is the National Centre for Science Information Systems Network (NACSIS). It interconnects seven major Japanese university computing centers providing researchers with an efficient means to share scarce supercomputing resources. Services such as real-time video, voice, full text, and graphics are being developed and integrated in NACSIS. It is interesting to note that U.S. President Bill Clinton has cited Japanese initiatives as justification for greater U.S. investment and development of more advanced networking technologies.

The European program is called the Cooperation for Open Systems Interconnection in Europe (COSINE). It was originally organized as a consortium of 18 European countries and the Commission of the European Communities (CEC). Similar to JUNET and NACSIS, COSINE aims to created a pan-European telecommunications infrastructure for education, business and government. Funding was made through the CEC and individual European countries. The resulting network is called EuropaNet.

Two developments make EuropaNET a unique initiative. First, EuropaNET will offer European researchers the first truly pan-European telecommunication backbone. Until very recently this has been a near impossibility; use of different telecommunication protocols by the European Community made the interconnection of national networks far more difficult. A second development arising from the establishment of EuropaNET is the extension of networking services to East European countries such as Poland, Hungary and the Czech and Slovak Republics. As a result, researchers in those nations will be able to join the evolving virtual research community.

In the United States, Gore's initiative resulted in legislation that established the necessary infrastructure to develop and implement a new high-speed network, namely the *High-Performance Computing Act of 1991* (P.L. 102-194). The blueprint for action is outlined in the Act by the establishment of the *High Performance Computing and Communications Program* (HPCC). The HPCC will fund research and development for the creation of new computing and telecommunication technology. The ensuing telecommunication infrastructure arising from the above program is called the *National Research and Education Network (NREN)*, one of four principal components of the HPCC[1]. The NREN has four primary objectives:

Establishing a gigabit network for the research, education, business community and fostering its most widespread use;

Providing a testbed for the development of advanced networking technologies and accelerating their application and use;

Catalyzing the deployment of a high-speed general purpose and use digital information highway for the nation;

Support and enable the success in the other components of the *High-Performance Computing and Communications Program.*

Of interest is that the above vision was be built on the structure of the former NSFnet. In fact, key sections of the NSFnet, or former U.S. component of the global Internet, was upgraded to operate at 1.54 megabytes per second (T1). The goal was to revolutionize without delay the ability of researchers, scholars, government officials, and scholars to carry out collaborative research and education activities regardless of temporal or spatial constraints. The collaboration that arose from the above network was viewed as the bedrock and foundation upon which the new national information highway will be built (Cerf, 1993, p.1; Hunter, 1992, p. 23).

The Clinton administration, in an effort to ensure the rapid evolution and continuation of the HPCC initiative, launched a program called the *National Information Infrastructure* (NII). Essentially, the NII was the Clinton Administration's first attempt at defining its vision of the upcoming gigabyte network. Of note is the NII's call to extend universal access so that information resources are equitably available to all citizens at affordable prices . Continued exponential growth of use, therefore, was assured.

Educators should follow the progress of the NII, because it has the objective to ensure the evolution and objectives of initiatives such as the NREN. Not surprisingly, the call for K-12 Internet connectivity is echoed throughout the NII (United States, Information Infrastructure Task Force, 1992). The objective is to connect all U.S. K-12 schools to the Internet so as to allow students the benefits of telecommunication technology. By 1996, a new initiative, the President's Educational Technology Initiative, announced by President Bill Clinton in his State of the Union address, promised to provide American schools with local and wide area network connectivity (United States, President's Committee of Advisors on Science and Technology, Panel on Educational Technology, 1997, http://www.whitehouse.gov/wh/eop/ostp/nstc/pcast/k-12ed.html). Consequently, the interconnection of schools to the Internet was given even more priority.

The Canadian Network for the Advancement of Research, Industry, and Education (CANARIE) can be viewed as Canada's proposed national electronic highway. Unlike the NREN, however, CANARIE is not the result of legislation. The catalyst for CANARIE came from a federal department, Industry Science, and Technology Canada (ISTC), that commissioned a feasibility study in 1989 to examine the possibility of establishing a state-of-the-art research network (J. F. Hickling Management Consultants, 1989; Bjerring, 1992). The study concluded that "The proposed Network is feasible in terms of the economic, technical, and implementation aspects," and that the Network "...be implemented quickly in order to capture the maximum benefit for users in the research development, and education communities, and to capture the 'window of opportunity' for the information technology industry" (J. F. Hickling Management Consultants, 1989, p. x).

After a meeting in 1990 where sixty leaders from the Canadian research, education, and government communities met to discuss the feasibility of the project, it was decided that the project should be a collaborative endeavour between the private and public sector and, similar to the NREN, it should be built upon the existing telecommunication infrastructure, namely the regional networks and CA*net.

In 1991, ISTC sponsored the Network Organization Conference. Participants agreed to create a committee and four working groups, Business, Governance, Marketing, and Network Architecture (a fifth group, Regional Networks Upgrade and Economics Benefits Working Group was created at a later date) with a mandate to establish plans for the creation of a research network. Briefly stated, the primary objective of the working groups was to detail the infrastructure needed to implement the network by January 1, 1993 (Silva & Cartwright, 1992, p. 6).

Essentially, the project aimed to expand Canada's former telecommunication backbone, CA*net, which served to interconnect the ten provincial networks (Canadian Network for the Advancement of Research, Industry, and Education Business Plan Working Group, 1992; CANARIE Associates, 1992). The goals and objectives of CANARIE reflect many concerns found in the drafting of the NREN, namely:

> To enhance the competitiveness of the Canadian business community through the development and use of state-of-the-art communications networks;
>
> To provide an environment in which the Canadian information technology industry, and in particular, those smaller firms which have traditionally faced significant access to

barriers to both technology and markets, can accelerate the development of future generations of open networking technologies, products, applications, software and services; To support more effective research, development and education through enhanced collaboration and access to information resources worldwide. (CANARIE Associates, 1992, p. 9).

However, full potential use of network resources and services remains problematic. Upgrading of broadband services, for instance, lag behind U.S. efforts. Whereas the NSFnet had upgraded its Internet lines to T3 speeds (45 megabytes per second) and then implemented speeds up to 155 megabytes per second as soon as possible, CANARIE's three phase network implementation approach planned to upgrade CA*net lines to T1 (1.54 megabytes per second). T3 broadband services was to be available at the completion of phase 2, (1995-1997) (CANARIE Associates, 1992, p. 49). T1 speed is simply too slow for many of the potential and needed applications demanded by users of the network.

The National Test Network (NTN) with its telecommunications partners was created in 1994 with financial support from CANARIE. Its objective is to foster greater collaboration among industry, universities, hospitals and government research institutions. The resulting collaboration should test new technologies and software to create new service capabilities. At the time of implementation, NTN was one of the world's largest high-speed, broadband networks. The NTN offers incredible flexibility through its high-speed DS3/OC3 (45 Megabytes/ 155 Megabytes), Internet (TCP/IP), and Asynchronous Transfer Mode (ATM) connectivity.

In 1997, CANARIE launched the world's first Next Generation Internet network, CA*net II. This new network offers research participants interconnection with speeds up to 1,000 times faster than today's Internet connections. It also offers Quality of Service (QoS) technologies thereby ensuring reliable delivery of multimedia content, an especially important element given the current interest in real-time video teaching applications. CA*net II will offer researchers and industry insight into new applications and services. Developers hope that lessons gained from use of CA*net II will create commercial and educational applications.

However, Canadian and Quebec public lobbying efforts for greater equitable access to the network has trailed U.S. efforts. Consequently, the debate in the U.S. whether the NREN is to be a fully public or private network is simply absent in Canada; although CANARIE received substantial government funding and support, it was developed primarily by the private sector. CANARIE has, therefore, traditionally emphasized the academic and business communities to the disadvantage of the K-12 and general public communities. However, new lobbying initiatives from the public and education sector are underway.

The Freenet movement is indicative of these new initiatives. Simply defined, Freenets are public community telecommunication networks that do not charge user fees. They are an outgrowth of the National Public Telecomputing Network (NPTN), a research project conducted at Case Western University. The NPTN is a nonprofit organization that works to ensure the provision of "free" and equitable electronic information and telecommunication resources and services to the general public. All members of the community are able to access and use the network. And, most importantly, the system is under the administration and supervision of the community; most of the network support is provided on community-wide volunteer basis.

Perhaps the best known Freenet is the Cleveland Freenet, which in 1986, became the first fully operational community network. By offering access to the Internet, the Cleveland Freenet makes publicly available resources that are deemed valuable to the public at large: Databases, file transfer protocol, electronic mail, etc. School librarians and K-12 educators find the Freenet particularly valuable because of its flexibility in introducing students to electronic resources and databases. Moreover, "via community computers, school systems finally have a cost-effective way to teach telecomputing to their students, thereby sending a new generation of information-literate citizens into the workforce" (National Public Telecomputing Network, 1993). And perhaps it is for this reason that educators and public and school librarians have been particularly active in the Freenet movement. Freenets are now active in Ottawa, Victoria, Halifax and other Canadian cities.

A lobbying effort that had a significant impact on school and public libraries, was the Canadian Educational Networking Coalition (CENC) whose aims closely resembled those of K-12 network lobbying groups in the U.S. Although the CENC has been inactive for approximately 2 years, Harvey Weir (Personal communication, June 2, 1998), its founder and professor at Memorial University in Newfoundland, plans to reactivate it in the near future. This group represented K-12 educational networking interests across Canada and submitted formal projects to CANARIE for the development of a network to support K-12 education and research.

At the founding meeting of the CENC on May 20, 1993, participants included federal and provincial representatives, educational research centers and institutions, and private industry. Of interest was the participation of CANARIE Inc. along with the federal department Industry, Science and Technology Canada (ISTC) which gave support to the idea of establishing a number of committees to oversee efforts to promote greater K-12 networking. Of these committees, the CANARIE Application Committee offered support to schools and educational institutions that presented funding applications to CANARIE Inc.

An endeavour that found support from CENC was the British Columbia CANARIE Education Applications Consortium initiative called the Canadian Online Exploration and Collaborative Environment for Education (COECEE) development project proposal. In essence, the proposal aimed to enable any Canadian "to enjoy enhanced and equitable access to the best distance education, training and learning opportunities" (Hoebel, 1993). Of especial interest is that the introductory COECEE system attempted to offer tele-learning and tele-tutoring services through software based on the Virtual Interactive Environment for Workgroups module developed with the Open Learning Agency and Simon Fraser University (Hoebel, 1993).

Consequently, the COECEE project offered CANARIE the opportunity to extend its services and resources to the K-12 community. Or, as stated by Hoebel, "The ability of the COECEE system to extend the reach and accessibility to advanced information, communication and learning resources will offer an effective complement to CANARIE's existing thrusts to upgrade backbone networks and to develop advanced test network facilities" (1993). The project, therefore, attempted to deal with an environment where several mutually beneficial developments were taking place: The exponential growth of the Internet, the growth of Canada's telecommunication networking infrastructure arising out of the CANARIE initiative, and most important, the growing interest by Canadian educators, researchers, and librarians in gigabyte networking.

The COECEE Project was the precursor to Virtual-U (http://virtual-u.cs.sfu.ca/vuweb/), an online Web-based system which allows universities, schools and other institutions or organizations to present their courses online. Originally developed at Simon Fraser University, the Virtual-U Research Project is part of the TeleLearning Network of Centres of Excellence and is funded in part by CANARIE. McGill University, along with seven other Canadian universities, is a field-test site for use of Virtual-U.

# APENDIX B

## B.1. An Internet Course for Teachers

To deal with the problems of acculturation and on-going instruction and support, it was decided, to design a course through the McGill University Distance Education Program that offers teachers the technical skills needed to use networking technology while at the same time giving them the conceptual knowledge needed to use and navigate the Internet. Also, and more importantly, the course itself would serve as an acculturation to the behavior and interaction found in an online environment. This acculturation would arise out of the interactive and communicative potential of the Internet. It would offer teachers the ability to join Communities of Learning and the means to create such communities in their schools.

This approach finds supports in the U.S. Office of Technology Assessment's report, *Teachers and Technology: Making the Connection:*

> To use technology effectively, teachers need more than just training about how to work the machines and technical support. To achieve sustained use of technology, teachers need hands-on learning, time to experiment, easy access to equipment, and ready access to support personnel who can help them understand how to use technology well in their

teaching practice and curriculum (1995, http://www.wws.princeton.edu/~ota/disk1/1995/9541.html).

Arguably, then, this reinforces the notion that acculturation to the technology through continuing education and interaction is the foundation to introducing successfully the technology to teachers. That is:

> Extending the learning community beyond the classroom walls to form virtual communities across time and space not only enriches the knowledge base available to students but also exposes them to models of reasoning and reflection about the learning process itself (Brown & Campione, 1996, p. 300).

The original design of the course based on workbook exercises and readings was deemed inappropriate because it lacked sufficient interaction and asynchronous communication. Moreover, the dynamic and ephemeral nature of Internet resources made it a necessity that modifications to the course be implemented without delay. Finally, students had to be acculturated into network behavior and etiquette, an exercise that requires an applied and humanistic approach as opposed to a theoretical and systemic approach (Silva & Cartwright, 1993a). That is, an approach that incorporates the community of learners perspective with the applied participatory design methodology. The new course faced a number of other challenges as well.

Although students are expected to have a basic understanding of computers and file management, it was decided that the project should give students some technical support and introduction to new Internet applications. Currently, home connections to the Internet and exercises like file transfers are greatly simplified. Still, some procedures remain complicated, particularly when students are inexperienced in using Windows/Mac software or Unix shell accounts. To accelerate the acculturation into the new environment and to emphasize the conceptual aspects of the project, a method had to be available giving the instructor the means to help students to resolve whatever initial technical problems that may arise.

In addition, introduction of new technologies, particularly those that offer real-time communication and interaction, requires that users become accustomed with new environments. That is, the use of new technologies for teaching changes radically the means to instruct and guide students. Often, the role of teachers is modified from one where they are information providers to one where leading and guiding becomes the primary activity.

Moreover, use of the Internet also requires instruction on how to collaborate in virtual environments and on how to filter and process large quantities of data and information. Indeed, the problem of information processing and filtering is a major concern and many are questioning whether the information on the Internet is an impediment or an enhancement to learning (Duchastel & Turcotte, 1996, p. 2). The information overload problem is exacerbated by the problem of information authentication and copyright. At the present time, there is almost no quality control on the information posted on the Internet.

If seminar participants are novices, introduction to general online behavior and culture is necessary. Again, the need for acculturation and "netiquette" should not be underestimated. Creating context, especially social context, in virtual environments depends upon certain behaviors and adherence to rules.

However, two major problems arise when introducing and teaching networking technology. First, the Internet and its protocols are evolving at an unprecedented rate of speed. The World Wide Web (WWW) is only a few years old with new software being introduced on a monthly basis. Furthermore, the WWW is designed to subsume or integrate many of the older protocols like gopher, telnet and ftp (file transfer protocol). These protocols, however, are still utilized by many technologically underprivileged schools which must rely on Unix shell accounts or similar systems.

Such rapid growth of change creates a situation where the student and instructor must be exposed to continuous renewal and new technologies and applications. A Windows-based task, for instance, assumes a great deal of knowledge from someone who uses text-based systems. Consequently, ongoing workshops geared towards the introduction of new applications becomes a necessity. While small-group workshops and seminars are probably the most effective means to introduce new networking technologies and applications, they are unrealistic given the lack of expertise and resources, particularly since universal access to the Internet is the goal.

The second problem, then, arises as a consequence of the first: How to offer personalized, humanistic workshops to deal with the constantly evolving, ephemeral, and dynamic environment found on the Internet. Or, in other words, how can a school implement a program where learning and use of new technologies is maximized and is offered on a continuous basis to all of its teachers and administrators. And how can a school offer follow up seminars and workshops and user support in a time of severe and continuing budgetary constrains.

### B.2. The Virtual Classroom and the Provision of Individualized Instruction

Simply stated, one of the challenges confronting Canadian schools is the provision of individualized instruction on a large-scale, ongoing basis during a time of severe budgetary constraints. Recent research (Butler, 1995; Ellsworth, 1995; Kearsley, Lynch & Wizer, 1995; Lewis, Whitaker & Julian, 1995; Reidlinger & Weir, 1995; Riel & Harasim, 1994; Spargo & Kelsey, 1996; United States, Office of Technology Assessment, 1995), however, are reinforcing the findings of earlier studies on the benefits of networking technologies.

And in recent research on the WWW, Gordin, Gomez, Pea and Fishman (1997) argue that Web technology can aid in the construction of school-based and work-based learning communities. This work lends further support to the claims made by researchers advocating teleapprenticeships as a new mode of learning. New programming languages like Java (Sun Microsystems, 1996) and Microsoft's ActiveX have also increased the interactive potential of WWW applications like Netscape's Navigator.

These languages make content on the Internet dynamic by allowing small applications called applets to be sent over the network and executed on the user's WWW client (i.e., Netscape, Internet Explorer, etc.). Interactive exercises and teleapprenticeships can be promoted to a greater degree when using these new technologies. These research findings become particularly important in Canada where distances are great, access to telecommunications varies and where expertise is available but the tools to foster collaboration and dissemination of research are costly.

Building on the original Internet course, it was decided to expand it to give teachers the knowledge to implement networking projects in their classrooms. The course would emphasize the conceptual aspects of educational networking while helping teachers deal with the technical problems associated with working in a virtual environment. However, the revised course faced several problems.

While teachers in urban centers had easy access to the technology and expertise, teachers located in remote Northern regions of Canada lacked resources. Moreover, the traditional methods of distance education, mailings and fax, were ill suited to deal with a dynamic and evolving environment like the Internet. Teachers needed hand-on experience, meaningful tasks and technical support. Furthermore, because of the speed in the evolution of Internet applications, immediate feedback was required to maintain interest and to lessen frustration in learning and using the new technology.

To meet the above demands, it was decided to design a course to maximize the interactive potential in networking technology while allowing students to experience the social learning and interaction that occurs in a real classroom. The course would also attempt to implement Brown's Fostering Communities of

Learners approach where all members are co-teachers and co-learners. The original and present course (Internet Resources, Distance Education Program, Faculty of Education: 432-408, http://www.education.mcgill.ca/432-408) emphasizes an apprenticeship mode of instruction thereby giving each student personalized and group attention. Finally, instructors and students are able to replicate the social learning that occurs in classrooms through the use of asynchronous (electronic mail) or synchronous (Internet Relay Chat) communication. Consequently, collaborative and group work is encouraged whenever possible. Situated learning, therefore, is achieved since students must use the Internet to participate in the course.

During the first year of the course, electronic mail was the primary protocol utilized. Gopher and the World Wide Web were still under development and unavailable to the general Internet public. Most students used UNIX shell accounts or an IBM mainframe mailer program based on Multi-User System for Interaction Computing (MUSIC) software. Students were required to use the primary Internet protocols, telnet, file transfer protocol and electronic mail and locate materials in support of their final assignment. Use of electronic mail, through an electronic mail discussion group created for the course, allowed students to communicate with one another, with the instructor and with persons not associated with the course. Office hours were available through Internet Relay Chat or MUSIC Chat, a surprising popular application with students.

In the course, students were able to work collaboratively, communicate with experts outside the classroom, receive course materials, initiate and participate in classroom discussions and work under an apprenticeship mode. And through the use of telnet and file transfer protocol, students were able to search, locate and retrieve a wealth of material in support of their work and projects. Finally, Internet Relay Chat increased the communication and interaction between students and professor.

With the evolution of Internet protocols, particularly the WWW, the course encouraged students to shift from the use of UNIX shell accounts and other text-based systems to more interactive systems. By early 1995, teaching and communication were offered through a WWW homepage created exclusively for the course. Although the older protocols like gopher, telnet and file transfer protocol are still an integral component of the course, students are encouraged to forego their use, especially since Internet browsers like Netscape's Navigator subsumes them making it unnecessary to learn their complicated command syntax.

Still, the WWW homepage is designed to maximize communication and interaction. This is promoted through several means. First, the foundation of the original course, the electronic discussion group (listserv), remains an essential component of class activity. Students must post the answers to course modules on the discussion group and participate actively in the discussions.

Second, students are able to communicate with their instructors via electronic mail or Internet Relay Chat. Office hours are available through IRC where students are able to discuss their progress in the course, research interests, etc. Group meetings through IRC are also available, although their freewheeling style impedes more structured discussions.

Third, a USENET-based reader news group was created so as to give students an alternative means to share expertise and knowledge. The advantage of a reader news group is that the information is easier to locate and retrieve. Fourth, a section on the homepage allows the students to post their biographies, portraits, and interests. This category aims to create classroom memory while fostering classroom identification. As well, this category allows students to post their work for comment and feedback from others in the course. Last, students are able to create personalized homepages containing gopher or WWW sites found to be of interest or of use for their classmates.

These applications fostered the development of social learning, situated learning and sharing of knowledge present in real-time classrooms but absent from traditional distance education programs. Indeed, so popular are the interactive and communicative aspects of the course, that the impact of new technologies like the WWW appear to be of less importance.

That is, the success of the course appears to be the result of the interaction arising from older protocols like e-mail and Internet Relay Chat as opposed to access to online materials and WWW technology. World Wide Web technology does contribute to different modes of completing the course, makes navigation of the Internet far easier, and integrates a hypermedia environment with a traditional learning approach. Nevertheless, the interactive element in the course is its foundation and the component most responsible for its success and popularity.

B.2.1. Practical and Conceptual Elements of the Course

There are three types of assignments that students must complete to finish successfully the course. The first is divided into six practical modules covering all Internet protocols: Electronic mail, WWW, telnet, ftp, http and gopher. Naturally, electronic mail is the first application covered. Through these modules, students have the opportunity to deal with technical problems and complete applied exercises. For example, in a typical module, students must telnet to the ERIC database, conduct a search on a topic of interest, save the file and mail it to their instructor. Or, they must conduct a search using one of the many WWW search engines like AltaVista or Lycos, find materials on K-12 networks and share it with the class.

These exercises also allow students the opportunity to evaluate online resources, deal with the myriad of technical problems that arise, and begin to share in learning process of how to function in a virtual environment. Students, therefore, are encouraged to post difficulties encountered while more knowledgeable students are encouraged to suggest solutions. Often, problems are resolved before the professor is made aware of them. The incidental benefit is that the activity promotes awareness of the interactive potential of network technology. It also fosters acculturation to the virtual environment.

These exercises also meet one of the primary needs of teachers using new technologies: Access to support and instruction. The benefit of this approach is that it allows teachers to participate actively in the presentation of the course. Students are constantly switching roles; within a single discussion session it is usual for a student to be both learner and instructor.

Students must also complete two brief assignments. These are both applied and conceptual and allows students to use their newly acquired technical skills. In the first assignment, a full review of computer and telecommunication resources in their schools must be undertaken. In this manner they are made to understand the technical obstacles to implementing a classroom-based Internet project. That is, they must survey their environment and decide if the school has the infrastructure necessary to support a network-based project. They must know, therefore, the technical requirements needed as well as how to evaluate the many types of projects available. For example, would a pen-pal project be more appropriate than a WWW-based project, given the constraints in their schools.

In this assignment, they also have the opportunity to plan for the integration of traditional learning and information searching with new technologies. School libraries, for instance, are suggested places to install networked computers; the librarians, because of CD-ROM technology, are often the most knowledgeable about computers. As well, it allows the teacher to introduce students to new technologies while complementing the technologies with traditional tools like handbooks and encyclopedias.

In the second assignment, they must search the Internet for K-12 codes of behavior, compare and evaluate several codes, and create one for their schools. Here they must successfully search the Internet for Acceptable User Policies, evaluate the policies in the context of their schools, and create one for their students. The knowledge gained should reflect concerns when implementing a project, knowledge of available questionable materials, and the awareness that parental support is an integral component of any successful Internet project.

Both assignments integrate technical knowledge with conceptual issues: What happens if students access questionable materials, should parents sign the user code of behavior, how does one plan for an Internet project, etc. They encourage the student to examine their environments and compare it to those of their classmates. Finally, the assignments foster knowledge of the materials available on the Internet while creating an environment that is conducive to social learning and situated cognition.

The final assignment offers students the possibility to research in-depth an issue that is of particular interest. Many have taken this opportunity to implement projects in their classrooms or to create seminars for other teachers. Others have used the assignment to lobby their schoolboards for more computer resources and funds. The development of a homepage for their schools has also been a popular option. Whatever the assignment, it must be supported by research and deal with current issues and problems. That is, fundamental questions should be posed: Why implement a project, how to evaluate the effectiveness of a project, how to integrate traditional learning tasks with the new technology, how are gender differences fostered or eliminated in the use of the Internet, etc.

The course also strives to present different viewpoints and research. Persons that have had a role in the development of educational networking are invited as guest lecturers. Their presentations are given to students through the course electronic discussion group and are later posted on the course homepage. Participation by persons with high-profile involvement with the Internet offers the course authentication.

Furthermore, research suggests that guest lecturing can stimulate learning in an electronic environment (Cotlar & Shimabukuro, 1995). To date, the Honourable Frank McKenna, former Premier of New Brunswick, Carol Baroudi, co-author of the book *Internet for Dummies*, and David Johnston, Chair of the Canadian Information Highway Advisory Council have participated in the course. All participants give the students the opportunity to communicate with them via electronic mail.

An additional resource that is appreciated by students is a virtual library that contains the full text of over 20 electronic journals on education. It also offers access to databases, full-text books and dictionaries and help modules on the use of the WWW browser, Netscape Navigator. In addition to the library, students have access to full-text bibliography of course materials to help them complete their projects. The bibliography includes journal articles, books, reports and presentations.

To resolve the problem of telecommunication costs, many students have restrictions on their online time while others must dial long-distance to reach the server, the entire course WWW homepage is archived on 2 diskettes. In this way students can copy the homepage onto their hard disks and access course materials locally on their computers. This does not lessen the interactive potential of the course; they can always connect to other servers or send e-mail whenever the need arises.