THE KEYPAL PROJECT AND INTERNET RESOURCES:
SUPPORTING COOPERATIVE WORK
BY CHILDREN IN DIFFERENT COUNTRIES

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ABSTRACT
The elementary and secondary school community of teachers and students is a growing population of users on the Internet. In general, this group of users approaches the Internet with less experience in network technology and fewer technical and user support resources than other Internet user groups.

In this paper we provide information about educational resources available on the Internet. Most of the information has been obtained through the use of the World Wide Web (WWW) using a MOSAIC interface at the University of Waterloo. We also discuss how information and software available through the Internet can support cooperative work between children located in different countries such as Brazil and Canada. This form of cooperative work is exemplified by the KEYPAL project and its use of Internet resources.

Author Biographies
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1. Introduction
Students in schools are educated in relative isolation. They interact with their peers within the school or their own social circle, with their teachers, and have limited access to learning resources. Rarely do they communicate with the local or global world outside the classroom except through field trips, personal vacations or through contrived one-way communication mechanisms such as television, films and now multimedia. Most of their interactions with the world are arranged through the eyes of adults. Communication with other students in other countries and cultures is rare, and then usually very slow because of the nature of the postal service.
Modern computer/communication networks such as the Internet, provide the facilities to support a new form of cross-cultural student-directed education that can and should dramatically enhance students' knowledge of other cultures and languages. Networks allow access to tools that support simple and fast methods for personal and group communication, and also allow the use of services and data from computers at remote sites.

The Internet is a large collection of interconnected networks that allow world-wide communication with diverse groups of people and computers. With an account on a computer connected to the Internet, it is possible to access resources on any other Internet computer on which the user has an account, and on Internet computers that offer publicly available information. In addition, it is possible to send electronic mail to other Internet computer users. All the thousands of networks that comprise the Internet can communicate because they use the same basic communications protocols.

The Internet dramatically expands classroom resources by allowing access to resources from all over the world to students, teachers, and media specialists. Users of the Internet can almost instantly bring information, data, images, and even computer software into the classroom from otherwise inaccessible locations. Access to these resources can support individual and group projects, collaboration and idea sharing over large geographic distances, and provide curriculum materials, not available in schools without Internet access.

Internet access also makes contact and relationships with people all over the world possible, bringing into the classroom experts in every content area, new and old friends, and colleagues in education. With access to the Internet, the site in which a user works can become a valuable supplier as well as a consumer of information. The expertise in one school can be shared with others around the world. The isolation inherent in the teaching profession is well-known among educators. By having access to colleagues in other parts of the world, as well as to those who work outside of classrooms, it is possible to end the isolation and provide a richer educational experience for both students and teachers.

2. An Overview of Internet Resources

The Internet is a collection of more than 10,000 interconnected computer networks around the world that make it possible to share information almost instantly. The networks are owned by many commercial, research, governmental, and educational organizations and individuals. The Internet allows the more than 1.5 million computers and 10 million users of the system to collaborate easily and quickly through messages, discussion groups, and conferences. Users are able to discover and access people and information, distribute information, and experiment with new technologies and services. The Internet has become a major global infrastructure for education, research, professional learning, public service, and business and is currently growing at the rate of about ten percent per month.

In what follows we provide a brief summary of some of the software available on the Internet to allow for the exploration of its valuable resources [1].

2.1. File Transfer Protocol (FTP)

FTP can retrieve files (from FTP sites) and transfer files to remote machines. FTP includes commands for such tasks as listing files and directories, changing directories, and transferring files.
2.2. Telnet
Telnet is a method for running a program on a remote computer, transferring the screen display to your machine while sending your keyboard data to the remote software.

2.3. Archie
Archie is a form of "librarian" that automatically and regularly accesses a large number of Internet servers and indexes their files to create a single, searchable data base. Actually, Archie is not a single system; rather, it is a collection of servers.

2.4. Wide Area Information Server (WAIS)
WAIS attempts to monitor the vast data resources of the Internet by making it easy to search for and retrieve information from remote data bases, called sources (collection of files) in WAIS terminology.

2.5. Gopher
Gopher is a menu-driven program that enables the selections from a menu. The choices are of three types. The first type leads to a sub-menu of further choices that may be on a different server than the current Gopher server. The second accesses local resources for data. The final type leads to a request being sent out on the network to retrieve files or yet another list of information from another Gopher server.

2.6. The World Wide Web (WWW)
Gopher is a hierarchical menu structure: menu items, lead to other menu items or to a service. The World Wide Web (WWW) model handles all the Internet's data as hypertext.

2.7. USENET
USENET is a "giant" bulletin board that can be accessed from many networks. The user participates in "newsgroups" covering a very large number of topics.

2.8. LISTSERV
LISTSERV is also known by the following names: discussion groups, conferences or lists. A LISTSERV discussion group allows a message to be posted to which others can respond.

3. Internet Resources for Primary and Secondary School Communities

To be able to provide the information presented in this section we have used MOSAIC at the University of Waterloo to access World Wide Web (WWW). Most of the information came from the Educational Resources Information Center (ERIC) Digests Archives (to be described later in this section) and reference [14].

We discovered, for instance, that the InterNIC gopher server has a section on K-12 (Kindergarten through 12th grade) Education, the Consortium for School Networking maintains a gopher server, and NASA's Spacelink is directed at primary and secondary school educators. NYSERNet's Empire Internet Schoolhouse is an extension of its Bridging the Gap program. For access to these resources, browse the Internet Resource Directory for Educators [8].

Many people on electronic mailing lists such as Ednet, Kidsphere, and the Consortium for School Networking Discussion List (cosndisc) post their projects and ask for partners and collaborators. For instance, our KEYPAL project, to be described in the next section, has been posted in these lists and we are currently in touch with several researchers to
share experiences. The K-12 hierarchy of USENET News has several groups where educators post these invitations as well.

For news groups and mailing lists of special interest to educators, see the "Ednet Guide to USENET Newsgroups" [3] and "An Educator's Guide to Email Lists" [4].

As we explored the Internet, we discovered that there are some tools that help find projects that are already developed. A good overview of many of these resource discovery tools is the "Guide to Network Resource Tools" [13] written by the European Academic Research Networks (EARN) Association. It explains the basics of tools such as Gopher, Veronica, WAIS, Archie, and the World Wide Web, as well as others, and provides pointers for finding out more about these useful tools.

Projects which use the Internet sometimes request sites from all over the world to contribute data from their local area and then that data is compiled for use by all. Weather patterns, pollutants in water or air, and monarch butterfly migration are some of the data that have been collected over the Internet.

There are a number of specific projects of interest to researchers and students. KIDS-94 (and subsequent years), managed by the non-profit KIDLINK Society, is one example. It currently includes ten discussion lists and services, some of them only for people who are ten through fifteen years of age.

Another place to look is Academy One of the National Public Telecomputing Network (NPTN), which usually has between 5 and 10 projects running at a time. The International Education and Research Network (I*EARN), a project of the non-profit Copen Family Fund, facilitates telecommunications in schools around the world. Chatback Trust, initiated to provide Email for schools in the United Kingdom and around the world with students who have difficulty communicating for mental or physical reasons, and Chatback International, directed at any school on the Internet, maintain an international network server that is interesting to investigate. The European Schools Project involves approximately 200 schools in 20 countries and has as its goal building a support system for secondary school educators.

"Internet Resource Directory for Educators, Version 2" is also available on-line [8]. It was prepared by a team of 46 teachers in Nebraska and Texas who were enrolled in telecomputing courses at two universities in 1992 and 1993. Ednet's "Educator's Guide to Email Lists" [4] is available electronically, as is the "Ednet Guide to Usenet News Groups" [3]. ERIC offers several documents relating to telecommunications and education, including the ERIC Digest "Internet Basics", the ERIC Review "K-12 Networking", "Instructional Development for Distance Education", and "Strategies for Teaching at a Distance".

There are also printed guides to the Internet appearing along with the many new books on the Internet such as [1, 5, 9, 10, 11, 12]. The problem with paper resource guides is that the Internet is a changing environment, so they become outdated quickly. One answer to the problem of printed Internet guides is the newsletter. NetTEACH NEWS is a newsletter specifically for primary and secondary school educators interested in networking. It contains information on new services on the Internet that are of interest to educators, projects for collaboration, conferences, new books and publications, and includes "The Instruction Corner", which gives practical tutorials on using network tools and services. NetTEACH NEWS is published ten times a year, and is available both in hard copy and via Email [8]. Three organizations deserve a special reference.
3.1. AskERIC  
ERIC Clearinghouse on Information Resources  
Center for Science and Technology, Syracuse University  
Syracuse, New York 13244-4100, USA

According to a recent electronic brochure, "The Educational Resources Information Center (ERIC) is a federally-funded national information system that provides access to an extensive body of education-related literature. ERIC provides a variety of services and products at all education levels." Another portion of the electronic brochure states, "AskERIC is an Internet-based question-answering service for teachers, library media specialists, and administrators. Anyone involved with K-12 education can send an EMail message to AskERIC. Drawing on the extensive resources of the ERIC system, AskERIC staff will respond with an answer within 48 working hours." Educators may have questions about primary and secondary education, learning, teaching, information technology, or educational administration which AskERIC can answer. Parents AskERIC is a new service for parents looking for information to facilitate their children's developmental and educational experiences.

3.2. Consortium for School Networking  
P.O. Box 65193  
Washington, DC 20035-5193 USA  
Phone: 202-466-6296  
Fax: 202-872-4318  
EMail: info@cosn.org

According to a recent brochure, "The Consortium for School Networking is a membership organization of institutions formed to further the development and use of computer network technology in K-12 education." To join CoSN, request an application at the above address. To contribute your ideas, lesson plans, or projects for others to access over the Internet, send EMail to: ferdi@digital.cosn.org

3.3. European Schools Project  
University of Amsterdam  
CICT/SCO  
Grote Bickertsstraat 72  
1013 KS Amsterdam, Netherlands

The European Schools Project is "a support system for secondary schools to explore applications of educational telematics."

4. The Requirements of KEYPAL: An Internet-Based Research Project.

In order to discuss how we plan to make use of Internet resources in our research project we first need to describe its many facets.

There is a theoretical side of the project involving the analysis of "language/action" elements [15, 16] in cooperative problem-solving mode supported by computers and telecommunications. The results of this research will be used to support the design of tools for cooperative work among elementary and secondary school students and will not be discussed in the present paper.

The KEYPAL\textsuperscript{1} project involves students ranging from 9 to 11 years of age and teachers from the Saint Daniel's School in Kitchener, Ontario, Canada and the Teresiano School in Rio de Janeiro, Brazil. The academic

\textsuperscript{1}KEYPAL, the name for the project, was proposed by the students in Brazil and Canada.
supervision of the project is provided by the Systems and Computing Program (COPPE-Sistemas) of the Federal University of Rio de Janeiro, Brazil and the Computer Science Department of the University of Waterloo in Canada. The first phase of the project (preliminary communication between children and teachers) started in the Fall of 1993 [19].

One of the main objectives of the KEYPAL project is to investigate the viability of supporting a cooperative learning environment between children raised in significantly different cultural environments [20, 21]. Children use electronic mail and other Internet resources to cooperate in two types of tasks: the joint development of texts, and various forms of non-mathematical problem solving. We chose the areas of cooperative writing about everyday experiences, and problem solving in domains such as geography and history to stress the cultural contents of the exchange.

We believe that with the teacher's assistance at both sites that are connected via electronic mail, students will be motivated by the interchange with a different culture and will be able to improve their writing skills and their knowledge about some important aspects of the social sciences. We also believe that this will occur even if the students work cooperatively in a very unstructured setting with loosely defined goals, relative freedom in the choice of discussion topics, and use of a minimal protocol in their communication with peers. These conjectures should be confirmed through extensive experimentation. An important objective of the study is to develop and test a methodology to support and analyze cooperative work in the Internet among primary school children.

The KEYPAL Project currently focuses on the following techniques and social differences to examine the effectiveness of electronic communications for educational purposes:

I Pen Pal Letters
Students need to know something about the people with whom they are communicating before they become involved in specific projects.

II Bulletin Board
The goal is to motivate students to write more frequently as a means of improving their skills in language arts. Bulletin boards allow a more full exploration of the influence of "audience" on students' writing and revision capabilities.

III Bilingual Education
The concern with bilingual education grows with the necessity for at least one of the groups to communicate with people that do not have English as their first language.

IV Cultural Differences
Promotes moral development and combats egocentrism because students from different geographical locations work cooperatively.

V Foreign Language Teaching
Learning a foreign language is beneficial to students because it provides mental flexibility, might be useful to them later in life, and will enable them to understand other cultures better.

VI Social Studies
Telecommunications can greatly enhance social studies curricula by providing far more access to current data and information than is
available from local libraries. The focus must be on problem solving, rather than memorization.

VII Communications Among Teachers Through Networking
Teachers from different countries have a way to share experiences while working cooperatively.

Based on the description of these factors we are now able to state the project’s requirements for Internet resources. The requirements may be informally expressed in the following ways:

Requirement 1. Project participants will primarily use electronic mail. As the project develops, new software to support cooperative work will be identified.

Requirement 2. The project will need to form a small repository where its own publications (authored by the researchers, teachers and students) and related publications relevant to the project will be kept.

Requirement 3. The project needs to share its experiences with the experiences of similar projects in other locations.

Requirement 4. Researchers and teachers need to be able to find publications related to the topics being considered within the context of the project.

Requirement 5. The project should maintain a project database with information about the participants and the work they produce. This database is a key support item for the analysis of the project data to be performed by its researchers.

5. Planning the Internet Resources to be Used in the Project.

In this section we indicate how our project will take advantage of the resources available through the Internet. In Figure 1 we summarize the project framework.

Figure 1 shows the project FTP site within the Internet. The groups in the two countries will use the site as the repository referred to in Requirement 2. The repository will contain the two kinds of publications mentioned in the illustration: technical reports and children’s essays and messages.

Requirement 1 is trivially supported by the Internet since electronic mail is one of its most important applications. Requirements 3 and 4 are supported by the contact with interest groups and by the use of the various search techniques available through the Internet. In the previous section we illustrated through examples how the various search systems available on the Internet may be used to locate information relevant to our project.

The FTP site also contains a simple database system (Requirement 5) built with WATFILE [18]. The simple data model for WATFILE is presented in Figure 2.
FIGURE 1

<table>
<thead>
<tr>
<th>Control</th>
<th>File</th>
<th>Edit</th>
<th>Columns</th>
<th>Rows</th>
<th>Globals</th>
<th>Calculate</th>
<th>Summarize</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 lines transferred to printer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculate...</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Number...</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Substitute...</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>More...</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evaluate...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WORK UNIT</th>
<th>FILE SUBJECT</th>
<th>MESSAGES ESSAYS</th>
<th>STUDENT</th>
<th>FROM</th>
<th>SUBJECT KEY WORDS</th>
<th>SUB. CFA</th>
<th>QUESTIONS KEY WORDS</th>
<th>QUES. CFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xmas Advent</td>
<td>M1</td>
<td>Tania L. C</td>
<td>Christmas</td>
<td>*O</td>
<td>Advent</td>
<td>*P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Advent</td>
<td>M8</td>
<td>Chris V. C</td>
<td>Jesus</td>
<td>*O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Christmas</td>
<td>M3</td>
<td>Group B</td>
<td>Christmas</td>
<td>*O</td>
<td>Brazil</td>
<td>*P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Christmas</td>
<td>M1</td>
<td>Meigham C</td>
<td>Holidays</td>
<td>*O</td>
<td>Games</td>
<td>*P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Gifts</td>
<td>M2</td>
<td>Erin C. C</td>
<td>Board Games</td>
<td>*C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Gifts</td>
<td>M8</td>
<td>Chris V. C</td>
<td>Computer</td>
<td>*C</td>
<td>Like</td>
<td>*P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Gifts</td>
<td>M11</td>
<td>Pedro B</td>
<td>T-Shirt</td>
<td>*C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Habits</td>
<td>M5</td>
<td>Yola W. C</td>
<td>Cards</td>
<td>*O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Habits</td>
<td>M8</td>
<td>Chris V. C</td>
<td>T-Shirt</td>
<td>*C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Habits</td>
<td>M10</td>
<td>Pedro B</td>
<td>Trees</td>
<td>*P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Music</td>
<td>M1</td>
<td>Tania L. C</td>
<td>Santa Claus</td>
<td>*P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xmas Weather</td>
<td>M7</td>
<td>Melissa C</td>
<td>Snow</td>
<td>*O</td>
<td>Snow</td>
<td>*P</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ESCAPE EVALUATE and STORE an EXPRESSION in a COLUMN ENTER

FIGURE 2

Note that the database describes the organization of the different directories generated by the project. Directories correspond to work units. One example of a work unit developed in 1993 in the KEYPAL
project is Christmas (Xmas). The files in the directories correspond to subjects developed within the work units, and Advent, gifts, or habits are subjects or themes related to the work unit Christmas. Each file (subject) consists of various messages and essays. Each message contains discussions about the theme and the essays are the result of the cooperative work. Messages may be prepared by individuals or groups.

For the detailed analysis of the activities in the project the data model includes two sets of key words. The first set includes agreed upon keywords about the themes or subjects. The second set includes three categories of sentences: conversation for clarification (*C), conversation for possibilities (*P) and conversation for orientation (*O) [15, 16]. The sentences in the messages are actually marked by the symbols *C, *P and *O before they are stored in the files for later reference. A record in the data model also records a key word related to the given type of sentence.

6. Conclusions

We have shown how the Internet dramatically expands the environment of the classroom by making many resources from all over the world available to students, teachers, and researchers in education. Internet access also makes contact with people all over the world possible, bringing into the classroom educational colleagues as well as experts in many areas.

We have used the MOSAIC at the University of Waterloo to access WWW for the purpose of discovering educational resources on the Internet. We have also compiled information obtained from many people on electronic mailing lists such as Ednet, Kidsphere, and the Consortium for School Networking Discussion List (cosndisc). We have used those lists to announce our project and learn about similar experiences. Several pieces of useful information regarding Internet navigation for locating educational material for elementary and secondary school teaching has been included in the body of this paper and in the references.

The report has also presented the KEYPAL project between Canada and Brazil and has stated the project’s requirements for Internet resources. It has also described the project organization which is intended to take full advantage of cooperative work in the environment provided by the Internet.

References

Those items marked with an asterisk (*) are available free on-line.


[3] * "Ednet Guide to Usenet Newsgroups" online: nic.umass.edu
pub/ednet/edusenet.gde

pub/ednet/educatrs.lst

1067


[7] * "FYI 19 "Introducing the Internet--A Short Bibliography of Introductory Internetworking Reading for the Network Novice"

[8] * "Internet Resource Directory for Educators" online:
  tcet.unc.edu
  pub/telecomputing-info/IRD/IRD-telnet-sites.txt,
  IRD-ftp-archives.txt, IRD-listservs.txt, and
  IRD-infusion-ideas.txt


[13]* "Guide to Network Resource Tool", Earn Association, May 1993. on line:
  naic.nasa.gov
  files/general_info/earn-resource-tool-guide.ps and
  earn-resource-tool-guide.txt


