

AN OVERVIEW OF COMPUTER NETWORKS IN EDUCATION: USING NETWORKS IN THE CLASSROOM

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INTRODUCTION

We have previously discussed [1] how the computer can be used as a means of communication between individuals and groups of individuals. Computer based communication is (among many things) 1) electronic mail ("e-mail"), 2) the transfer of a file from one computer to another, and 3) a large scale discussion of issues or topics. While electronic mail has advantages, it does not provide a forum by which several individuals can view the contributions of others. In the previous work, we discussed what a listserv is and how that can be used to develop a discussion list and consequently overcome some of e-mail's limitations. The evolution of discussion lists into electronic journals was also presented.

In this paper, we wish to examine how computer networks can be used in educational settings. It is possible to use computer networks to develop courses, teach courses and seminars, and have teachers and students (from elementary school through college) interact with other teachers and/or students. Such interactions do not require that the students be in the same classroom. In fact, it is possible for students to be in different states or countries when interaction takes place.

Networks can be one of two types. A local area network (or LAN) is one in which computers in different rooms of a single building or different buildings on a separate campus are connected together to facilitate sharing of software or messages. An extended network would be one that connects computers of different campuses. As of this writing, users of extended networks focus primarily on exchanging messages. Using one set of software over an extended network is possible but not common.

COURSE DEVELOPMENT, FACULTY AND STUDENT RESEARCH

It should be immediately obvious that computer networks can be used to facilitate communication between faculty members in different localities. Such a situation is described by McKenzie and Santora [2]. Faculty members at the University of Texas of the Permian Basin took the communication between individuals one step further and, through an interaction with members of the PHILOSOP discussion list [3], developed a reading list for a proposed

course in the History and Philosophy of Science. In the future, it would be possible for individuals to use computer networks to communicate with textbook authors and publishers about the nature of textbooks for certain courses and to design unique or personalized texts and other materials for courses. One of the teachers for a course entitled "The Physics of Space and Time" was the author of the text used for the course. Interaction with students gave him the opportunity to gather information which could be useful in preparing later editions of the text [4].

There is also an observable trend in some of the "professionally oriented" discussion lists (at least those that the authors subscribe to) that could be named "student research." Students (from upper level undergraduates to doctoral ones) use these lists to locate current research topics, research results, research papers and technical reports in selected areas. This would be similar to literature searches except that there is an interaction with those currently doing research in given area rather than an examination of previously done research. It seems that with the rapid growth in published results, such a form of communication between researchers will grow and increase research productivity by eliminating duplicate efforts.

TEACHER INTERACTION

Teacher interaction may take several forms. The WCU MicroNet serves as a database in earth science for teachers in western North Carolina [5] and the TNT network in New York has expanded the idea of a computer database. It is possible for teachers on this network to find out about jobs in other schools as well as find out information about students and resources for helping students [6]. The "Dead Teachers Society" is a listserv based in Indiana which offers teachers the opportunity to discuss teaching/educational items with other teachers nationwide [7].

NETWORK BASED COURSES AND SEMINARS

Courses can also be taught with the assistance of both LAN and extended networks. At the University of Missouri - Columbia, Irv Cockeriel offers a seminar in Education Research and Statistics that deals with e-mail and BITNET. Students in this course develop skills that enable them to use the computer to communicate with other individuals over the BITNET network and use computer networks as a research tool [8]. At UT Permian Basin, students in the science methods classes were given computer accounts in order to post class assignments to a conference system--VAX Notes (see also [9])--and to communicate with each other and the instructor via e-mail.

The Allegheny campus of the Community College of Allegheny County developed a network based approach for some of its instructional support. The development of a local area network on one campus has led to an increased use of computer facilities on that campus and the establishment of network connections to the other campuses in the system [10].

Faculty at the New Jersey Institute of Technology also developed a course structured to utilize a computer mediated communication system. There were two objectives in mind when this system was developed. The first was to increase the number of ways students could encounter educational experiences outside the traditional classroom. The second objective was to use collaborative learning processes to improve the quality and effectiveness of education. While it is not clear from the results of this project if an electronic classroom is better or worse than the traditional classroom, it does seem that the availability of computer based learning networks leads to increased participation between certain groups of students. It was noted that one month after the course was completed there was still interaction among members of the course [11].

A recent conference at the University of California, Riverside, described how philosophy courses in logic and critical thinking could be taught using a network approach and software developed by David Kaplan and Robert Martin. Each participant in the conference described the hardware running the course program and how they were using that program to supplement their lectures. Most integrate the program with the lecture by requiring that homework assignments be done on the computer and then turned in for grading on either a floppy disk or a computer printout. Regardless of the requirements imposed by the instructors, they all reported that their students had fun with the program and that it created what they called the "study hall" effect. That is, many students cooperated with one another in learning the program (which proved to be simple even for first-time computer users) and helping each other learn logic. All the participating instructors were enthusiastic about the program and some felt that they had not yet tapped its full potential [12].

Norman Coombs, a professor of history at the Rochester Institute of Technology, pointed out that there are several advantages to using the computer for teaching [9]. One advantage is that, because computers are available 24 hours a day, students can leave messages with the instructor and other students at any time and are not limited to class time participation.

At the UT Permian Basin, there are a variety of "computer supported" courses taught using a local network. The computerized classroom consists of 30, 286-based PCs linked together in a LAN and connected to the VAX 8200 mainframe. Faculty members from the Division of Business and Administration use the classroom to provide students with access to Lotus 123 and other business software; faculty from the Departments of Psychology and Sociology use the PCs as terminals to access the mainframe and use the SAS and SPSS libraries; faculty from the Department of Mathematics and Computer Science uses this classroom for programming and statistics courses. In addition the ISETL programming language running on the PCs is used to support the Discrete Mathematics course. Last semester Marcin Paprzycki used software provided by Rummelhard and McClelland [13] to support a course in Neural Network Computations. Using this computer classroom, Judith Cochran, Director of Graduate Reading, took software available on the market and created the UTPB Reading Clinic. This allows students to not only diagnose reading problems but provides them with a place and means to evaluate and learn about the current software [14].

Local area networks need not be limited to only colleges. Krieg described LAN use at the junior high level [15]. This network was developed to help meet the school district's computer literacy requirement and was based on success the district had with other network courses. T.H.E. Journal listed a series of courses which could be used over networks at the elementary and secondary level [16].

In North Carolina, the MicroNet allows teachers to take graduate level courses in earth science. Using the network gives the teachers the opportunity to take classes without having to drive long distances to the classroom. The same network also provides teachers with support for their classroom instruction [5].

A course entitled "The Physics of Space and Time" was taught utilizing extended computer networks. This course was offered through the University of West Florida and, during the 1990 spring semester, involved 51 students at 9 different universities and high schools. Of the 51 students, 17 were identified as high school students. The text for the course was agreed upon before the start of the course and the listserv was used to synchronize the lecture phase of the course and to assign homework. The computer network allowed the students to discuss issues related to the course and ask the course instructors questions [4].

The idea of using computers for teaching, be it with a local network or an extended network, has many proponents. Beals describes many of the aspects of networks, especially

in terms of how beginning teachers can use them [17]. The Journal of Distance Education, an electronic journal, deals with many issues relative to the topic [18].

STUDENT INTERACTION

In addition to the interaction of students in the classroom there is the possibility of interaction outside it. Computer networks can be used to allow students to communicate and interact with other students outside their immediate geographic area. In a time of immense political change, such communication would seem appropriate for understanding what is happening in other countries.

Two projects, KIDNET [19] and KIDS-91 [20] have been developed to connect students in classrooms around the world. Both were established so that children and their teachers would have an international computer network to use. The discussions concentrate on topics related to networks at the local, regional, and national level and services provided by these networks for children, K-12 audience and the handicapped. For both networks the spinoffs were created (KIDS and KIDSCAFE respectively) for children to send messages to other children without tying up the original network.

With real-time interaction such as provided by these networks and others, it becomes possible for students to discuss various items with other students. A social studies class in Massachusetts used their access to a network to send out surveys concerning the United Nations and received replies from students in Japan within twenty-four hours [21]. In a similar manner, students take part in the WorldClassroom project as a means of finding out more about the world in which they live [22].

It is easy to visualize the role of the listserv-type environment in establishing cross-cultural awareness of students. Many of the medium sized listservs have some international subscribers. It would thus be rather easy to establish teams of students from different countries to discuss problems of ecology, culture, society, politics, and other topics of interest they might come up with.

THE FUTURE FOR NETWORK BASED LEARNING?

How do we encourage and develop the use of computer networks in educational settings? The first thing one can do is to try to specify precisely what kind of advantages and disadvantages are connected with this new form of teaching. From our experiences at UT Permian Basin, it is clear that, by using computers in an interactive approach and computer networks, students gain a better understanding of how software can be used and will be used in post graduation situations. It also shows students that computers are not limited to mathematical/scientific problems and that programming is not a prerequisite for computer usage. Providing students with e-mail privileges also allows for an increase in communication between students and faculty. This is especially true if members of a group must commute to school. While not providing for face-to-face interactions, using e-mail does allow students to keep posted on class assignments and other group efforts and make for a better allotment of time. For more detailed discussions of possible the benefits and problems connected with computer supported teaching see [23] and [24].

For there to be any value gained from using computer networks, especially those in non-university settings, several things must be done. College instructors, both those who teach computer literacy courses and those who teach applications or evaluation of computer software, should begin to include the idea of computer networks in their course materials. John Chadwick noted that many teachers do not know of the existence of computer networks or that there is a possibility of a regionally based network in their state [25]. If there is

someone who knows about computer networks and what such networks can do, then the ability to use the networks at a given locality increases. David Basham suggested at least one person at each school who is computer-literate be identified and given a modem, software and instructions, and authorization to use the system. Once one person becomes adept in using networks, he/she will gradually spread the word to others [26].

For the people involved with the WCU Micronet, creating a network also meant working with school administrators. It appears that once they become aware of the network, many administrators will make their schools part of the system [27]. The support of the administrators is crucial to the success of computer networks in schools. Many teachers will not want to be involved because of a lack of time to devote to learning how to use networks. Administrators must help the teachers find the extra time for doing this. In addition, teachers must have access to the systems involved separate from student involvement. At least in the case of the EDS Project, teachers must "compete" with students for access to the system. If teachers do not have access so that they may communicate with their colleagues, then there is the possibility that they will not communicate at all and choose not to use the capabilities of the system [28].

CONCLUSIONS

Hopefully, this paper has given the reader some idea of how to use computer networks in the classroom. The reader is encouraged to obtain a copy of the "The Virginia Book" [29], which details computer networks on a state-by-state basis, in order to determine what networks are available.

It appears that, for many students, using computer networks to interact with students in other cities, countries, and cultures helps with the development of critical thinking and creativity based skills. In addition, by using computer networks, students can gain an appreciation for the idea that learning takes place outside the classroom walls and that it does not stop at the end of the school day or year.

A second educational outcome is an increase in the amount of learning done while operating in a collaborative or cooperative learning setting. The findings of the Virtual Classroom project at the New Jersey Institute of Technology suggest that there is an increased involvement by the students in the class and that the motivation for learning within that setting had increased [11].

The advent of any new technology has always caused problems for education. The rapid rise and even faster fall of educational television is one such example. Even the educational use of computers has undergone the cycle of acceptance and rejection. In this day of rapid changes, both scientifically and socially, there needs to be a method by which teachers and students can communicate beyond the walls of the classroom. Doing so will increase the amount of learning or make the learning in the classroom more applicable to the needs of all the individuals involved. The advent and access of computer networks gives educators and students opportunities not previously available.

ENDNOTES

1. Tony Mitchell and Marcin Paprzycki, "An Overview of Computer Networks in Education: Computer Networks and Network Services", Proceedings of the 2nd Annual South Central Small College Computing Conference, 1991, pp 1-8.
2. "A Guide to Establishing Mainframe Computer-Mediated Communication Between a Host and a Remote Site", Robert McKenzie and Gerald M. Santora, T.H.E. Journal, May, 1991. The reader may also want to look at Pierce, Glass, and Byers, Educational Research, January - February, 1991, for a discussion of other educational discussion groups.
3. For the list of available discussion groups and information how to become a member of such a group see [1], appendices A and B.
4. The address for the course is spacetim@uwf. If you wish to audit the course, contact st-audit@uwf.
5. "Using Distance Learning to Improve the Quality of Earth Sciences Education at Middle and Secondary Schools", Steven Petter Yurkovich, Patricia Grace Johnson, and Janice Miles Arden, Journal of Geological Education, 27, 1989, 314-316.
6. "TNT: An Ambitious Network From the 'Big Apple' State", Peter F. Stoll, T.H.E. Journal, May, 1991, 57 - 62.
7. One may subscribe to the Dead Teachers Society List (DTS-L) by sending a message to LISTSERV@IUBVM. If you have any questions contact the list owner, Scott Anderson (SOANDERS@INSTEPS).
8. Irv Cockriel, EDRSR438@UMCVMB.
9. "Liberation Technology: Equal Access Via Computer Communications", Norman Coombs, Instructional Computing Update, Vol. 2 no. 2., December, 1990, pp 2 - 4.
10. "Networking to Support Instruction In a Community College System", James H. Rossell, T.H.E. Journal, Novell Special Issue, 1990.
11. "Collaborative Learning: The Virtual Classroom Approach", Starr Roxanne Hiltz, T.H.E. Journal, June, 1990.
12. The UCSB Humanities Computing Facility has a copy of this program. If interested in a demonstration, call (805) 893-2208. If you are interested in obtaining a free copy of the program in either its network or stand alone version, call John Mandeville of the Philosophy Department at UCLA, (213) 825-6383.
13. Explorations in Parallel Distributed Processing A Handbook of Models, Programs and Exercises, James L. McClelland and David E. Rumelhart, MIT Press, 1988.
14. Reading in the Content Area, Judith Cochran, in press, 1991.
15. "Local Area Networking in a Junior High Applications Lab", Beverly M. Krieg, T.H.E. Journal, May, 1987, 64 - 67.
16. "Directory of Networkable Courseware", T.H.E. Journal, May, 1987, 83 - 86. A discussion of LAN courseware is found in the same issue on pages 12 - 14.
17. "Computer-Mediated Communication Among Beginning Teachers", Diane E. Beals, T.H.E. Journal, April, 1991, 74 - 77.
18. To subscribe to The Online Journal of Distance Education and Communication, send a subscription command (sub DISTED your_full_name) to Listserv@UWAVM. In addition, The American Center for the Study of Distance Education publishes The American Journal of Distance Education. The Association of Research Libraries is planning on producing a directory of Electronic Publications. For information about this journal, contact ARLHQ@UMDC.
19. For further information contact the administrator, Bob Carlitz (joinkids@vms.cis.pitt.edu), to subscribe write to: kidsnet-request@vms.cis.pitt.edu.
20. For further information about KIDS-91 and its associated services, contact Odd de Presno (opresno@coma.uio.no). To subscribe to the KIDS-91 or KIDCAFE lists, send a mail message to LISTSERV@VM1.NODAK.EDU.
21. Susan Barocas, barocas@umass.
22. "Young Students Get Global Perspective", T.H.E. Journal, May, 1991, 50-51.
23. "PC Networking at the University of Utah", Lee G. Caldwell and Harry P. Bluhm, T.H.E. Journal, May, 1987, 59-63.
24. "Electronic Distance Learning: Positives Outweigh Negatives," David L. Carl, T.H.E. Journal, May, 1991, 67-70.
25. John Chadwick, New Mexico Museum of Natural History, chadwick@unmb.
26. David Basham, basham@navvax.
27. Penny Johnson, johnson@wcuvox1.
28. Michael Halla, Electronic School District Project, University Computing Services, Indiana University, Bloomington, IN 47405, mhalla@insteps.
29. A Survey of Education Computer Networks, Thomas R. McAnge, Jr. and others, Virginia Cooperative Extension, Virginia Polytechnic Institute, Blacksburg, VA 20461-0524, June, 1990. This book lists 49 statewide networks currently in existence or being developed and 46 public access networks and databases. Many of the networks listed contain a contact person and phone number.