Current Applications

Teaching and Learning On-Line: Issues in Computer-Mediated Graduate Courses

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Abstract: Computer-mediated communications introduce a new spectrum of educational options for educators and learners today. Among the most exciting are the "electronic campus" and "on-line courses" designed and delivered via a computer conferencing system. Computer conferencing enables the development of a time and location-independent learning environment which in large part and with sound design may simulate educational interactions, both cognitive and affective, that occur on-campus. Certain key access restrictions such as geographic location, scheduling conflicts, availability of classes, physical handicap, travel time and cost become redundant. Beyond enhancing and expanding educational access, computer-mediated communications suggest significant potential for effective new learning and research interactions. Such design options have particular significance for graduate-level learning: for increasing learning access and for providing quality group learning opportunities. However, regardless of the level of education, little is as yet known or understood about the nature of learning and teaching within an on-line environment. This paper offers a contribution in its analysis of how computer conferencing supported learning in graduate level courses and in its conclusions for future research.

INTRODUCTION: NEW EDUCATIONAL OPTIONS AND CHALLENGES

'Electronic education'[1] is becoming a significant force as schools, colleges, and universities in North America and Europe increasingly offer course activities and programs on-line, using the computer as the medium for group communication. While existing experience indicates significant potential for enhancing and changing teaching and learning, there is a critical need for research to inform future developments. The Office of Technology Assessment (U.S.A.) recently concluded that information technology will likely become a major vehicle for responding to the educational and training needs of society in the next few

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decades. However, "much remains to be learned about the educational and psychological effects of technological approaches to instruction. Not enough experience has been gained with the new information technology to determine completely how that technology can most benefit learners or to predict possible negative effects of its use" (1982, p. 6).

Existing research on electronic communication has been largely limited to analysing technology-based media as a substitute or surrogate for more costly media (such as face-to-face activities) (Feldman, 1986). Current use of the new media as electronic analogues to, or substitutes for, existing media may be emphasizing efficiency over the qualitative advances which these innovations could offer (Vallee, 1982; Harasim and Johnson, 1986; Kaye, 1986). Many researchers echo Feldman's proposition that "it is possible that the strengths of the new medium will be in other areas than the strengths of old media. The new medium may even be used in ways not envisioned by those who designed it" (1986, p. 74). Johansen (1984) similarly strongly encourages moving beyond "horseless carriage" thinking which casts new applications of computers in the image of their face-to-face precursor.

Analysis and discussion of the specifically *educational* value of computer-mediated communications is only beginning to emerge as a distinct arena of research (Quinn Mehan, Levin & Black, 1983; Kaye, 1985; Riel, 1986; Hiltz, 1986). However, preliminary data indicate interesting results.

Hiltz, reporting initial results from one of the first major studies of the virtual classroom, observes that not only does the use of computer conferencing introduce *new* educational options, but in some cases this medium may even be *more* effective than the traditional classroom. She concludes moreover that the potential value of on-line education may well rest upon the ability of educators to use computer communications to offer qualitatively new educational options. "One important requirement for realizing the promise of new educational technologies is to use them to create new learning and teaching environments that are more effective and exciting for at least some kinds of materials, rather than merely trying to replicate the traditional classroom electronically" (1986, p. 104).

The point that *new* learning and teaching environments should be created on-line is suggested in other case examples as well. Haile (1986) reports that applications of computer conferencing which employed a highly teacher-structured and teacher-dominated approach did not noticeably improve the attrition rates or student scores. While acknowledging the preliminary nature of her research, Haile suggests the possibility of a positive direct relationship between teacher behaviours which stimulate student participation and students' retention in distance learning programs (p. 13). The implication is that teacher behaviours and cc course designs which encourage more peer interaction and take overt advantage of the group communication potential may contribute to decreased attrition rates and increased learning effectiveness (p. 1). Related to this position is the view that "a computer teleconferencing system applied to a collegiate course permits the superimposition of an 'electronic classroom' onto the asynchronous time availability and location requirements of distant learners, with all the motivational, intellectual, and pedagogical (or more accurately andragogical) advantages that come along with the close-knit classroom environment" (Deutschman, Kramers, Richards, Spitzer, & Haile, 1985).

The electronic medium opens new educational options for both learners and educators,

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[1] The terms "electronic education" and the electronic classroom are used interchangeably with other terms currently in use such as on-line education, the virtual classroom, and computer-mediated education.

not only in expanding educational access but also in redesigning teaching strategies and learning activities.

Since educational applications of computer-mediated communications are in their infancy, educators face both opportunities and challenges. We understand little about the new phenomenon of learning in an electronic space. There is as yet very little data describing or analysing teaching and learning within this asynchronous, text-based (screen) environment. What are the differences between on-line and face-to-face classes? What are the perceived advantages and disadvantages to teaching and learning in the on-line mode? Can we, in addition to improving educational access, improve the effectiveness of the educational interaction? Hiltz (1986) enquires whether computer conferencing, unlike many educational technologies, can contribute to preserving the advantages of interaction and fostering active learning while improving educational access and quality. She sets out a series of questions which provide a useful framework for this paper.

> How can we utilize computer-mediated communication systems to support effective, active learning? Can we provide facilities for the types of activities that usually occur outside the classroom, such as office hours, libraries, and even extra-curricular activities? Further, can the new technology-based modes of communication serve as more than an emulation of the process of face-to-face communication in the traditional classroom? Can they support a different, more active and involved style of learning on the part of the student? (p. 96)

The Focus for this Study

This paper addresses some of Hiltz's questions in its description and analysis of computer conferencing as a support for effective and active learning in graduate-level courses. Two explanations are relevant. The first is the view that graduate education has particular characteristics: contact between instructors and students should be frequent and intense; debate and dialogue should play a greater role (than in undergraduate courses) (Queen's University, 1975). Moreover, "students benefit greatly from the interaction with each other . . .studying alone in the library and talking individually with a professor are important but cannot replace the sharpening of skills among groups of students" (p. 31). Computer conferencing suggests itself as a potentially appropriate medium for a graduate level group learning activity.

The second relates to the understanding of effective learning. Effective learning can mean many things. In the Hiltz (1986) study, learning effectiveness was measured by "whether students take a more active part in the learning process and take advantage of the potential for more interaction with the professor and the other students, despite the absence of nonverbal cues to facilitate this interaction" (p. 100).

In this present study, the measures of effectiveness in learning were active user participation and user perceptions. This latter measure is in line with the growing recognition of practitioner wisdom which argues for the relevance and authority of feedback from the practitioner (Cook, 1985, p. 30). In the case described here, the participants were learners who have experienced a wide variety of learning environments (most are also experienced educators) and hence have significant experience as educational practitioners.

This paper reports on exploratory field research. In the tradition of qualitative research, the intention is to enhance the ability of the researcher to understand and ultimately devise an explanation which is consistent with occurrence in the social world (Cook & Reichardt,

1979; Patton, 1980). Qualitative and quantitative data were collected from participants in two graduate level courses which were offered entirely on-line. Data from students in both courses were collapsed for presentation in this paper. In a few cases, where appropriate, the data are distinguished as reflecting Course 1 or Course 2; in specific instances data from only one course were obtained.

Qualitative methods such as semi-structured interviews, participant observation, and analysis of selected conferences were employed to obtain user reactions to the use of cc as an educational delivery medium. As the interaction was entirely text-based, transcripts of the proceedings (of the course 'discussions') were available on-line and as printouts. Several on-line conferences, including course discussions, "Learning Log" (which recorded user impressions), and course feedback conferences (which solicited feedback on the experiences of learning on-line) were selected as key sources of data. Transcripts permitted the use of extensive quotation. A significant amount of participant experiences is provided here to show what it was like from the participants' point of view to be in the course.

Quantitative data in the form of usage statistics and responses to on-line polls and questionnaires were also gathered.

BACKGROUND

The Ontario Institute for Studies in Education (OISE) is a graduate school of education affiliated with the University of Toronto. Since 1985 OISE has used the Participate computer conferencing system in a variety of educational applications. The Participate system offers facilities for electronic mail, conferencing, real time (synchronous) messaging, electronic polling, editors (both line editors and the VAX EDT fullscreen editor) as well as search mechanisms whereby the users can locate conference items and topics. Additionally, Participate offers features valuable for designing an on-line educational environment. For example, the software has topic joining action which establishes a user record to keep track of what notes a user has seen in any topic joined; topic branching facilities that form groups easily as subsets of larger groups; access controls; and knowledge base editing which includes tools for moving subtopics so that they are better indexed, for modifying topic openers to summarize notes that follow, and tools for keyword search (Stevens, 1986). Advances in computer communications software are beginning to offer the possibility of a self-contained educational environment.[2]

The two graduate courses described in this paper were delivered entirely on-line, each over a twelve week period: Course 1 in the Winter Session, January-April, 1986; Course 2 in the Fall Session, September-December, 1986. Each course examined and analysed gender equity issues related to women and computers in education. Students were expected to log on at least two times per week, and to spend a total of 2-3 hours/week participating on-line.

The two courses had seventeen and twelve students respectively (in the former case, an additional 21 users participated as part of a non-credit professional development course). The majority of students were female; in each course there were three males. In both cases, there was a range of computer expertise: approximately 10% were novices, 20% considered

[2] OISE is moving towards the development of an "electronic campus" by offering courses, access to faculty and to learning peers on-line. It is also currently possible to access the OISE librarians, but the library catalogues and administrative services are not yet available within this electronic environment.

themselves experts; and the remainder were somewhat to quite comfortable with a computer.

Students were located in cities, towns, and remote areas around the province of Ontario and were linked with one another through their microcomputer, modem and a telephone line, whereby they accessed the Participate conferencing system housed on one of OISE's VAX 11/750 minicomputers. Through this link they participated in asynchronous conferences, sent and received electronic mail, used synchronous messaging, employed text editing, and participated in electronic polling.

Two instructors shared the tasks: one served as the principal course instructor while the co-instructor assisted. While in both courses the two instructors were the same, roles were reversed with the co-instructor assuming the principal role in Course 2.

Description of the On-line Course Activities

Design of the on-line course activities was considered the critical component since it would affect the quality of the learning environment. Two major factors influenced the course design: the features and character of the medium itself, and the learning situation.

Computer conferencing is essentially a group communications medium enabling groups of people to exchange ideas and opinions and to share information and resources. Conferencing systems typically provide opportunities both for *electronic mail* as well as for *conferencing* communication. Electronic mail by itself is a one-to-one, personal communication medium, while conferencing is designed to facilitate the interactivity of group communication, maintaining an ongoing transcript of the interaction among the many people discussing a topic. Additionally, the asynchronous nature of this medium allows for convenient access and some measure of control in interacting with and through the medium.

However, while conferencing facilitates and supports group communication, it does not guarantee it. Humphrey reports that "achieving an active membership appears to be one of the most difficult tasks confronting a conference organizer" (1985, p. 14). This difficulty seems characteristic of educational applications as well. Umpleby (1986) states that: "The most commonly discussed problem in on-line courses is how to keep students current with the discussion and active on-line". Haile (1986) describes the use of computer conferencing in distance education, but noted that there was little interaction among learners and that the conferencing activities were teacher-centered and teacher-dominated.

Our specific challenge then was to develop a design that was not only technologically appropriate and viable but also stimulated active participation and effective learning.

The course design built upon the distinctive character of the conferencing system to develop a learner-centered, group learning approach. The on-line educational environment was designed to take advantage of key features of the conferencing system (in particular, multiple conference spaces and branching capabilities) to create a rich and varied learning context. Rather than employ a single conference strand to house all the seminar sessions and learning activities, the branching facilities of Participate were employed to provide spaces for core and optional learning activities, for plenary, small group and working group discussions, and for informal (social) interactions. On-line polls were also employed to gather student reactions during the session. A number of educational activities were redesigned for the on-line medium, such as plenary discussions, debates, small-group discussions, working groups, class presentations, and group feedback and critiques. There were three phases to the on-line course: 1) four one-week "electronic" seminars; 2) on-line working groups and class presentations; and 3) final plenary sessions for feedback and reflection over the course topic

and process. While the course was carried entirely by computer conferencing, two face-to-face meetings were held to provide training, and a printed learning kit with course guides, readings, and technical documentation on computer conferencing was provided to each student at the outset (for additional information on the course design, see Harasim, 1986).

PRELIMINARY RESULTS

The results reported in this paper represent initial findings in an on-going study of computer conferencing and networking in education. Data on student participation, perceived effectiveness of learning, and advantages and disadvantages of on-line learning are presented here.

Rates and Nature of Participation

The goal of facilitating active learner participation was successfully achieved. Several measures (both quantitative and qualitative) were employed.

Analysis of usage data showed that students in the courses participated actively on-line throughout the session: averaging 4.2 hours/person/week in Course 1 (the range was 1.6 to 9.5 hours/person/week) and 3.6 hours/person/week in Course 2 (ranging from 1.4 to 7.4 hours/person/week). This rate was significantly higher than the required 2-3 hours/week or the 2.5 to 3 hours/week of classroom courses.

While time on-line provides some notion of the rate of participation, this measure became increasingly deceptive as students became increasingly adept at up/downloading conferences and working off-line. For example, the difference in time on-line/week between Course 1 and Course 2 may be partially explained by increased participation off-line. In Course 2 almost half the students reported downloading the discussions and doing much or most of their reading off-line.

Compared with time spent on a traditional-mode OISE course, in Course 1 100% of the students reported spending more time on the on-line mode, while in Course 2 50% of the students reported spending more and 20% approximately the same amount of time on the on-line course. In comparison with other OISE courses taken in the traditional classroom, the great majority of Course 1 students reported assuming *greater* or *much greater* individual initiative for the course as well as increased self-responsibility.

The rate of participation and interaction is also reflected in the number of messages and their volume (the number of characters) entered on-line. Examination of these factors indicates a high rate of student participation and a relatively equal correspondence between the student and the instructor.

Analysis of a representative core conference (a "seminar" on the same topic) in each course found that in Course 1 the principal instructor wrote 10% of the total number of messages, while in Course 2, the figure was 12% of the total number of messages entered. In relation to the volume of the messages (the number of characters written)[3], the principal

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[3] While there was no control over the length of messages sent, participants were encouraged to limit each message to 1-2 screens (with the exception of the class presentations). The average length of Course 1 student comments (in core conferences) was less than one half screen (805 characters). The average length of instructor messages was just over a half screen (1220 characters).

instructor wrote 12.5% of the message volume in Course 1, and 10% in Course 2.

Overall, analysis of the rate and volume of participation indicates very active involvement of the students and relatively equal interaction between students and instructors. The instructor played an active part: introducing the discussions: *"Make sure to read section 2 of the Introductory notes. Then let's discuss what we've observed about this, what we've experienced, what the readings have to tell us about how gender domains work, and what we can do to change this."*; providing information: *"I'd like to take up some aspects of the learning environment at the adult level. There is an accumulation of studies which shows. . .*; probing: *"In note 140 of this conference, Jane Doe*[4] *raises an important point. . .but I'd like to question how these differences come about. Is it something to do with school policies? funding? the professional opportunities for students in a given school?*; raising issues: *"This note takes up the debate. . .The most recent contributions to this discussion have located a contradiction. . .But at a different level, are these examples really contradictory?"*; focussing: *"Our discussions already show what a rich topic this is and how important it is to our understanding. . .But I can also see that it's getting to be almost too broad. I think that's partly the reality — but I thought it might be useful to try to clear up one or two things and make one or two points to help focus the discussion."*; and most commonly, synthesizing points which students raised, building upon and developing themes which emerged in the on-line discussions and linking these to the literature and the topic.

The instructor was involved, but did not emerge as the dominant "voice" in the on-line discussions and seminars. A poll of student reactions in Course 2 found that 90% of the students felt that the amount of instructor input was just right (there is no comparable data from Course 1).

Student responses to open-ended questions on-line provides insight into their impressions of participation in an on-line medium. The great majority (both those who were highly verbal and those who were more reticent in face-to-face classes) indicated very positive experiences.

"One-to-one I am a fairly verbal person, but I do not participate well in a class situation and never have. This medium enabled me to participate far more than I would have in a regular class. I have taken other OISE courses with some of the participants in this course. My observation is that those who tend to participate double or triple their contribution on-line. Quieter students catch up to where those active participants were before."

"As far as communicating in courses goes, I can definitely say that I contribute at least 50% more frequently in this course than in regular courses. I definitely feel more comfortable writing rather than speaking to a large new group."

"Overall, I feel very positive about online learning: in fact I am taking another online course next term. I have been much more of an active participant in this course than in any other OISE course. As other students mentioned, actual hours spent on the course have certainly been greater."

Effectiveness

Student assessment of the effectiveness of learning in an on-line course was very positive. In a poll of Course 2 students,[5] 11 of the 12 respondents reported that they considered

[4] The student's name was changed for this paper.

[5] There is no comparable data for Course 1.

the on-line medium to be *more* effective than classroom situations for some applications;[6] 1 of 12 responded that on-line education can be *as* effective as classroom learning.

To explore fully the reasons given by the students for the perceived increased effectiveness of the on-line medium would be beyond the scope of this report and the present stage of data analysis. However, in the next section, some preliminary feedback from the students on the perceived advantages of on-line learning is reported to help illuminate the results just presented and identify issues for further research.

ADVANTAGES OF LEARNING ON-LINE AS PERCEIVED BY THE STUDENTS

Analysis of student reactions generated a fairly extensive list of perceived advantages. Overall, student reactions to on-line learning were highly positive. Responses to open-ended questions as well as unsolicited comments entered in various conferences led to the identification of several key themes or dimensions. These are:

1) Increased interaction: quantity and intensity;
2) Access to group knowledge and support;
3) Democratic environment;
4) Convenience of access: the "24 hour" class;
5) User control over the learning interaction;
6) Motivational aspect; and
7) Text-based communication.

In this section we explore those dimensions which appear to have had the greatest significance for the students (this list is not rank ordered). The data portray a depth and scope of experiences and reactions; however, given the nature of the data sources, there are no figures on response rates.[7]

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[6] Two of these eleven specified they believed on-line education to be *more* effective than classroom education for adults but not, they felt, for children.

[7] The principal data source was comments (solicited and unsolicited) in various conferences. Computer conferences function somewhat like a conversation: this has the advantage of recording a variety of responses over a period of time and hence may reflect a greater range (and perhaps depth) of input. Conferences also have a disadvantage (for data-gathering) over questionnaires. Whereas each person responds to all appropriate questions in a questionnaire (thereby enabling the specification of response figures), a conference is often more like a conversation or discussion: after a certain point participants do not repeat a point made earlier by another person. One may add some remark to clarify her/his particular experience or perspective, but there is a sense that that position has been stated and now it is time to move onto a new point. Thus it is difficult to provide figures that accurately reflect student perceptions. The convention of using phrases such as "many students" or the "great majority" or a "few" has been employed to convey some indication of the weight of a particular position. Where available, quantitative data is presented.

Increased Interaction: Quantity and Intensity

Students were very positive about the rate and nature of group interaction facilitated by the conferencing system. The following comments reflect a general consensus: *"Interaction among participants: Superb!! The thoughts, ideas, suggestions, responses and support were greater in quantity and quality than I ever imagined or experienced in other courses".*

The branching capability enabled the design of a varied educational environment which facilitated both cognitive and affective communication. *"To me, the major success of this course has been the truly interactive involvement through the medium. There was always a large support group (including peers and instructors) to respond to technical, academic and even emotional (morale-boosting) needs. I've never been involved in a course in which I've learned so much from other students. This was the result that there was no competition for the floor [sic.]and therefore everyone was able to have her (generic use of pronoun) say. Also, as remarks were all documented, they were subject to more in-depth consideration than in the normal classroom".*

Not only was there *more* interaction, but students reported that the nature of the interaction was qualitatively different from classroom learning. Students experienced on-line learning as a more *intense* learning interaction. On-line learning had *"this continual sense of interaction. In the back of the classroom you can doodle quite happily; you're not expecting to be participating continuously. However, when you are at the computer, you are wasting your own time. You are either there to read notes, or to respond to notes. You are constantly required to be engaging with the computer, and that is very different from a classroom situation where, yes, you are supposed to be listening to a lecture but then you click off and draw a few circles and click on again. . ."*

Several students commented on this difference between learning on-line and graduate classroom lectures. *"There is a perception that you are on-going and active here; you're not sitting in any corner taking notes. It's not any external pressure, but I think it's the self-expectation".* This contrasted with face-to-face seminars as well: *"In seminars you can 'choose' to ignore discussions by assuming the 'graduate school stance': make like you are listening and ignore most of the conversation as 'white noise'. But online you cannot do that!"*

The text-based medium moreover, seemed to diminish shyness and fear of talking in large groups.

Access to Group Knowledge and Support

An interesting observation on increased effectiveness was the perceived opportunity to access a larger pool of knowledge and experience through the shared database. *"I learned much more than in a regular 3 hour course because of the interaction of all the students in the course. It is much more enriching this way. Through this medium we could tap the combined knowledge of the group".* The group interaction provided a greater source and scope for information: *"the information exchange is more diverse in that input is coming from everyone rather than only from the instructor".*

The value of the diversity of interactions was often expressed: *"I found it very interesting to be able to communicate with such diverse people and to be able to communicate with each of them. I mean, I minded about the lack of personal interaction, but in plain truth, when one thinks about it in a classroom situation, one tends to get to know maybe one or two people in that class and those people you go to coffee with or have a. . .(whatever forbidden fruit appeals to you). But in this situation there was a sense in*

which one was able to make communication with each person and that was interesting."

Students also noted an increased sense of group responsibility: *"I know one girl commented on line that whereas if she had enrolled in a class, she would miss the odd class and think nothing of it. If she didn't come on line for a period she felt very guilty and badly about it. As though she were letting people down. . .It's a perception that here is the whole group of which you are a part, attempting to do something. And, because you are a part of the group, if behooves you to participate in doing it."*

"I think it is somehow different from a classroom, because her feeling was that if she did miss a class or two, she was responsible to no one except herself. My interpretation of this is that in the classroom, that she was only impeding her own progress: she wouldn't get the information, or whatever. Sitting in a class she would normally not be a participant. The other members of the class would lose nothing by her absence. Whereas, online, in the the computer conferencing situation, since it's very much a group input at all times, then a sort of period of absence (I think she felt and I also felt) isn't just harming oneself. It's influencing the amount of information that's available and the amount of reaction that's available to the group."

Democratic Environment

Several factors contributed to the perception of electronic conferencing as a democratic environment. One in particular is the absence of physical or social status cues in the text-based environment. Students observed that in the cc environment, *what* was said becomes more important than who was saying it, thereby diminishing stereotyping associated with physical appearance. *"In on-line discussions, I think that there is a tendency to respond to content rather than to personalities."* This was deemed particularly important for over-coming gender and racial-based discrimination.

On-line education, moreover, was seen as promoting more equitable participation. *"Conferencing as a course vehicle promotes more equal interaction among participants, dropping barriers of geography, urban/rural styles, social skills, mannerisms."*

The lack of competition for air time was another important factor in encouraging more active participation. An advantage of computer conferencing is that everyone can participate to the degree that she/he wishes. Discussion is not limited to those who think quickly and have the verbal skills to participate in a class discussion. For those students by nature less assertive, on-line learning was found to be more conducive for self-expression. As one student observed: *"The nature of conferencing allows an individual to finish her thoughts without fear of interruption by some keen, more outgoing colleague. I feel that this is a great equalizing force in a group."* This sentiment was shared by students who were shy or more hesitant in group situations as well as by those for whom English was not their mother tongue and who often felt overwhelmed in a face-to-face class. In the regular classroom, they remark, it is often difficult to compete for "air time" with fluent English speakers.

Other differences between classroom learning and the on-line medium were noted: *"It has been very interesting to take a traditional course alongside this one. I have noticed that the time I spend interacting with students in my other class is severely limited. I have also noticed that there is a protocol observed to varying degrees in the classroom which directs all communication through the teacher. It is considered rude to ignore the teacher and discuss a particular point with another student. The result has been that I do not know the other students in the class very well. Again, I would like to know them better but I probably*

never will have the opportunity." While some students felt that heated discussion also can occur in a classroom, it was noted that even so *"the teacher has a good deal of responsibility for establishing, through body language and tone of voice, that such discussions are either OK or more suited for the cafeteria. I still see such discussion largely happening through the teacher. (On the other hand) although teachers can guide in this (on-line) medium, they simply cannot take a central role."*

Students also reported increased cooperation in the on-line environment. *"I think that this system is wonderful for communication and I can add that there is a lot more communication here than I can find in my on-site course. Also, I feel a greater sense of cooperation within this group."*

Motivational Aspects

The use of cc as a tool to overcome geographic and temporal boundaries to access a dynamic group communication proved highly motivational for several participants. *"The excitement of talking person to people through the screen is fascinating. It really stimulates the mind. I can foresee great possibilities for on-line courses."*

"Does anyone else find this addictive? Since getting this modem, I have spent more time than my husband or kids at the keyboard."

"I am cold. I need to clean my lenses and I'm thirsty. Yet, I'm still here. Know why this is better than tv--the anticipation of a good show, great cast of characters, fast-moving plot, thought-provoking and, like a serial, the end is not in view."

"Many have expressed the notion of getting "hooked" by on-line communication and I'm one who just had to read what's going on even though I am sick and should be in bed. I think we should give serious attention to health hazards of computer addiction."

Convenience of Access: the '24 hour class'

OISE's conferencing system, and hence the on-line classes, were open 24 hours a day, seven days a week. Students reported increased learning as a result of the availability and flexibility of the 'class': *"I find myself thinking about the ideas in the on-line class more because there is no 3 hour limit of class time."* The positive assessment of the '24 hour class' was common among the students. *"The school came to me as often as I wanted."*

"The amount of learning in this course for me has been more than any other course. You can't measure learning easily, but let me tell you that if exposure is an acceptable measure, I was at school almost daily. It was for me a much more than one 3 hour class per week and some reading at home."

Freedom from travelling was another important variable: *"I don't have to worry about traffic jams, road conditions, parking space, etc."* This factor has particular significance for part-time adult students who typically attend classes in the evening, after a full day at work. As a result they are tired, perhaps stressed, and often hungry, all of which detract from the effectiveness of their learning.

Another aspect of on-line learning was that: *"Being able to bring course material and participants into my own environment has allowed me to make it more a part of my life than one in which I participate at a great distance, in time and space, from my own setting. My reflections from the course are interacting constantly with my everyday life, at home and at the school where I teach."*

Increased User Control over the Learning Interaction

Many respondents commented that learning effectiveness was significantly enhanced because they felt some controls over the learning situation. *"It allows me to maximize learning because I can go on-line during my peak brain awareness period. I am not enslaved to rigid classroom attendance which most of the time may not fit my best learning time."* Furthermore, *"the format enables us to devote more focussed attention because we can choose times to participate when we will not be interrupted or disturbed."*

Another comment attributed wider personal significance to the experience. *"Never have I watched the end of a course with the sense of regret that I now feel. Yes, it took a lot of time but the pay-offs were wonderful. The availability of the conference almost whenever I wanted was worth everything. Lifestyles today are so fast-paced and stressful that having some control over when to get involved is a blessing!"*

A benefit of asynchronicity reported by many students was the control over the nature and time of interaction. This provided a measure of self-pacing in the learning interaction: the user could choose to reply immediately, to reflect before responding, or to compose a response. Students felt that this feature contributed to the quality of their interactions. *"I think that one of the most positive aspects of 'on-line' learning is that I am able to read and then have time to think over my response or whether or not I wish to respond. My thinking time can vary from two minutes to two weeks. I enjoy this flexibility of the medium almost as much as my access to OISE."*

Control over *reading* the discussions was also welcome. Participants appreciated the opportunity to 'catch thoughts as they fly by' on the screen. It was possible to let the comments/ideas scroll by or to pause and reflect upon one particular comment. Moreover since these 'thoughts' were stored in the conferencing database, it was felt easy to recall and review those that seemed particularly important.

A unique feature of computer conferencing, noted one student, is the ability to reflect back and locate oneself within the class discussions: *"It's really great to be able to read my own contributions to see where I fit into the chain."*

Text-based Communication

Several advantages are attributed to the text-based medium. Two which received particular attention were the ability to read the discussion and to maintain a written (and permanent) record of the interactions. *"My reading speed has probably increased 50% during the past months. I have always preferred to 'see' comments rather than listen and try to take notes. I never could write fast enough in lectures, so I generally listened and participated but ended up with no notes, or hieroglyphics which were undecodable next week."* Another noted that, *"the record of the conversation enables me to check and double-check, not to rely on memory. Moreover, now I don't have to spend time making 'memory joggers'."*

These factors contributed , some felt, to the effectiveness of the interactions. To excerpt from an earlier comment: *"As all remarks were documented, they were subject to more in-depth consideration than in the normal classroom."* Another noted *"I feel that I'm giving more ideas more thought because I'm seeing them rather than just hearing them."* Several students noted the advantage of *"being able to read a comment and get my head together before I respond."* This advantage also carried over, for some, to text-based responses: *"Conferencing has the major advantage for me in that I like to write out my thoughts rather than speak them in class."*

A final comment comes from the student who summed up her experiences by paraphrasing another writer: *"I don't know what I think until I see what I write."*

DIFFICULTIES REPORTED BY STUDENTS

This section considers some of the difficulties which students reported in relation to learning on-line. The themes which emerged in the on-line conferences were:

1) Information Overload;
2) Asynchronicity (delayed responses);
3) Inconvenience of increased access;
4) Following on-line discussion threads;
5) Loss of visual cues; and
6) Health concerns.

The majority of difficulties identified seem linked to the process of 'learning to learn' in this new and unfamiliar medium. It is not yet clear whether the problems reflect inherent disadvantages or are temporary; the result of other factors.

Information Overload

One of the major problems raised by students was 'information overload'. Given the high rates of participation (text-based discussion) together with the course reading list, the amount of reading became very heavy. The problem was particularly reported by course participants in the large group (40 members), in which number of on-line comments daily was significant. This group reported frequently feeling frustrated with the large number of notes in their inbox. Course 2 students had mixed reactions: about half reported sometimes feeling frustrated by the number of messages, while the other half reported enjoying finding lots of notes in their inbox.

Students in the on-line courses, moreover, were confronted with two dimensions of learning: the content and the context. Although 80% of students in both courses reported learning the basics of on-line communication (reading and writing comments) within 4-6 hours, the first days and weeks of using a new communication medium can be stressful. Students had to digest information related to both the course content and context.

Several students noted a negative side to high rates of participation and interaction, particularly in the case of a large group: a sense of guilt. *"Does anybody else feel guilty when you go to log off and the computer says: You have 100+ notes and you still want to quit?' One night I changed my mind and kept reading because it impelled me to keep on."* This remark generated two responses: *"I usually get bullied by that too. Mainly because of the daily volume of notes. If I log off and leave the 55 notes, I get the dreads about whether I will be able to take all that will be facing me next time I log on. Is anyone else feeling overwhelmed?"* This was exacerbated in the case of one who did not have adequate access to the necessary equipment. *"The major problem was the extensiveness of the information that had to be processed each week. Working with neither a printer nor a home computer (which I could log onto when I'd forgotten something) was a handicap."*

A few students observed, however, that information overload was typical of most courses. *"I too suffered from a little information overload during the first five weeks, but*

frankly I find that happens in any course I take. . .it's just that when the comments are on a screen rather than in spoken form, it becomes a visual reminder of how much I'm not understanding. I really think that the feeling of 'overload' is what creates the tension to begin action towards classifying information and attempts to clear out extraneous information."

Hiltz and Turoff (1985) observe that there are no easy solutions to avoiding the trade-offs between the value of open communication and the cost of information overload in computer-mediated communication. System solutions are imperfect and behavioural solutions appear to be the best strategy for dealing with this phenomenon at the moment.

And students did in fact begin to develop strategies to deal with the 'overflowing inbox'. Students reports of information overload were more pronounced in the first weeks of the course. As they became more adept at conferencing and familiar with the 'terrain', many students began to find ways to deal with the problem. Some strategies were individual, such as learning to read selectively, using the scan command, and commenting more selectively, while others were social, such as encouraging colleagues to write shorter messages. There were mixed degrees of success: what is clear is the need for research and development activities in order to understand and facilitate on-line learning.

Asynchronicity: Delayed Responses

While asynchronicity has many positive aspects for on-line learning, negative effects were also reported: *"The most frustrating point in our present mode is the delay in receiving feedback. One makes a comment and where normally there would be immediate verbal and non-verbal response, now there is only silence. It is like speaking into a vacuum."*

Another student found that although computer conferencing is asynchronous, a certain rhythm of interaction can occur. In the OISE courses, the majority of participants were part-time students (working full-time) and their most intense participation would frequently occur on weekends. On the other hand, a full-time student who used the OISE computer terminal around a five-day, 9-5 schedules felt 'out of sync' with the discussions. *"It means that when I come in on a Monday morning, I usually find a large number of notes to deal with. Then, during the week when I am regularly logging, I am not getting much reaction because we are out of phase."* This was particularly problematic during the phase of working groups: *"Throughout the working group I found I'm sort of sending messages out into the ether over the period of time when there isn't much response and then when I come in on Monday I find that some great quantum leap has occurred over the weekend."*

Inconvenience of Increased Access

While the overwhelming majority of students appreciated the ability to study on-line from home, one student reported that because she was at home, her children felt that could interrupt her study time. There was not the same demarcation between home/class as if she were travelling to school for three hours per week. While this was the only such situation reported, it may have important implications for others studying on-line in the future, particularly for women.

Another negative side to asynchronous learning is that *"the continuous nature of the course contributed to an excessive workload. I could never take a break because I felt that I could get behind."*

The increased accessibility and availability of the '24-hour' class also has the outcome that it never seems to end.

Following On-line Discussion Threads

Following the discussion threads in a computer conference is a difficult and almost inherent problem. Students experienced two problems in particular: keeping track of several on-going discussions; and deciding when to respond (whether to read all the comments first and then to respond to particular items or to respond as one reads along). *"Now as I feel more adept at using the system, I realize that it's not just the sheer volume of notes that's overwhelming, it's the strain of trying to follow ten or twelve conversations simultaneously. I have trouble keeping track of who said what, following a train of thought or the thread of the argument. I am torn between making an immediate response to a thought and the need to slowly figure out an integrated reaction. I wake up composing notes, I think about what has been said, I hash ideas out with my husband, I look forward all day to find out what others have said about some point or another."*

Commented another: *"I find. . .the business of trying to hold in my head what the notes are saying and how I may wish to react to them a little difficult. . .It's like trying to hold information from 9 or 10 screens of information, when really one's habit is not to hold all of it but just to hold what seems to be relevant at the time. Especially in the beginning, I found that I was going back and forward and back and forward, trying to form a coherent picture in my mind of what points the notes were making."*

Students sought ways to deal with this problem: *"Yes, it's hard to follow the conference as a 'conversation'. . .harder to pick up the threads. . . but it is like being in a classroom in some ways. Even in a classroom you can't interact with 40 people or 12 ideas at a time. It's better to pick up one or two of the ideas and people, at least that's what I'm finding."*

This experience returns us to a key issue: how students organize themselves to learn on-line. These students reported that the problem was greater at the beginning of the course. Presumably over time strategies were developed to deal with this issue, such as making notes, printing out particular discussions, focussing on one or two threads, using the search/find facility, and/or developing new ways to mentally record and organize the discontinuous information presented on-line. However, little (if anything) is as yet known or understood about this very important phenomenon.

Loss of Visual Cues

Physical and social status cues which typify face-to-face communication are absent in the text-based environment of conferencing. The absence of cues such as facial expressions, gesture, and voice inflection received a significant amount of comment at the outset of the courses. However, as the on-line activities and relationships evolved, these comments decreased.

The absence of visual cues was more important to some students than to others. In both courses, discussion about the significance of physical cues generated debate. When asked if having a photo of each student in the 'on-line class' would be helpful, there were mixed reactions. *"I don't think the image of a person's face helps conferencing. In fact, sometimes it may hinder because some of our prejudices are linked to visual cues. Not having an image means that we can step closer to on-line equality."* Others did not agree. *"I think that having a photo would help me form an impression about the ideas being presented when I can match my own interpretation of the individual who is saying it. In other words, I give value to the statements depending not only upon the ideas being presented but also on my own impression of the person who is expressing the idea."*

Some students wondered whether an inverse stereotyping, based on writing or perhaps even typing skills, might result in the on-line medium: *"Judging people only by their ideas and not by their looks is a real positive side of conferencing. However, the negative side is that we begin to judge people not only by what they say but how they say it. Personally, I do miss the nonverbal cues that go with face-to-face communication. I find it much easier not to misinterpret a point when I watch the speaker. Also feedback is immediate."*

"Another curious thing: you lose the nuances that come with voice delivery. Sometimes I feel sure that some on-line comment is tongue in cheek, but without establishing the personal rapport and knowing the personality of the person, it is hard to determine (brevity is the soul [or is it sole] of wit)." In an attempt to diminish such problems, some students began to experiment with typographical conventions such as **smile!** to convey a more subtle meaning in a comment and compensate for the lack of visual cues.

Health Concerns

On-line education is essentially text-based communication and requires sitting and reading a video display terminal for long periods at a stretch. This may create or exacerbate certain health problems. Two in particular were identified in this experience. *"I find it very difficult to read at the screen for long periods of time. . .physically. I find it's hard on the eyes for me. But then I'm older and my eyes are not particularly good. I think its partly because I have tri-focal glasses and the problem may be that because of the angle (of the terminal) I may be looking through the wrong strip. I become progressively more uncomfortable with it."* The second issue, as one person stated: *"I just hate sitting still that for that long."*

Other general concerns which were raised relate to potential long-term hazards of prolonged computer usage in general, such as eye strain, headaches, back problems, and exposure to radiation. Computer-related health issues are increasingly recognized in office environments and experts in ergonomics are developing solutions (i.e., quality monitors, radiation shields, ergonomically designed chairs). Such solutions are equally valid and important for the educational environment as well, particularly as computers become increasingly part of this milieu and, in the case of on-line education, the key medium of course delivery.

CONCLUSIONS

This paper explored a number of issues related to how computer conferencing can be utilized to support effective, active learning in graduate level courses. The first was to determine whether on-line courses could serve as more than an emulation of the process of face-to-face communication in the traditional classroom. On the basis of graduate courses analyzed here, the answer is 'yes'. The design of the on-line learning activities described in this paper was predominantly based on a learner-centered, group learning approach. Traditional classroom communication patterns typified by teacher-centered styles (such as the use of lectures) were not employed. While this reflects the teaching styles and perspectives of the instructors, it was also our impression from these courses that teacher-dominated techniques would not be very feasible within the electronic medium. Delivering a lecture on-line would be awkward, requiring instructors to input and students to read, screens of text on a video display terminal.[8] Such a design would not likely be attractive or acceptable to most graduate students or instructors. An authoritarian approach, moreover, is not easily viable

on-line. Whereas in the classroom situation the teacher is able to control (overtly or subtly) the flow, pace and direction of discussion, this is not the case on-line. Instructors do not have the same control over class activity on-line. Unless access is controlled, the 'class' is open 24 hours a day and users may enter and participate at will. Students 'have the floor' and control (to a considerable degree) how much they write and participate.

This leads to the second issue: can computer conferencing support a different, more active and involved style of learning on the part of students? An analysis of user rates and patterns as well as student reactions again strongly indicates the affirmative: computer conferencing has the potential to offer both quantitatively and qualitatively different and in many cases better learning experiences than that of the classroom. Students reported more active participation and interaction and more effective learning in the on-line course than in classroom courses.

Finally, we address the key question: how can we utilize computer conferencing to support effective, active learning? The conclusions that can be drawn from the case study presented in this paper are that one approach found very effective for achieving these goals on-line is the use of a collaborative group learning design. A collaborative learning design is based upon group discussions and interactions among learners, with the instructor as the learning facilitator. This design was reformulated for the on-line environment and the results were high rates of student participation and interaction and a very positive student assessment of the effectiveness of the learning experience.

There are, however, important design implications that need to be addressed in using a collaborative model on-line. Some of the more positive aspects of on-line learning can become 'double-edged'. For example, increased participation and interaction can lead to information overload, both in terms of the volume of input and discontinuity of discussion threads. Related to this is the need to manage and focus the discussions, particularly within the seminar activities, to avoid 'on-line brainstorming' — a situation in which comments do not relate to and build upon one another.

The courses analyzed here were based on a relatively short period of time: twelve weeks, in each case. It is both possible and likely that over a longer period of time individual practices would change as the students gain skills and develop strategies for learning on-line. Any novelty effect might fade as other pressures such as time constraints come to bear. Additionally, increased familiarity with and skills in on-line learning will likely affect the perception of advantages and difficulties which influenced earlier reactions.

Learning in a new medium does not appear to be simply a case of learning to use a new technology or using the electronic medium as a surrogate for other traditional modes of learning. Students in the courses invented new learning practices that facilitated effective and productive learning. The process whereby students adapt and create new learning practices has not yet been systematically investigated.

The experiences explored in this paper suggest many topics for future research. Given the early stage of our understanding of on-line education, there are almost endless possibilities. Research into design issues related to teaching and learning on-line is a major area requiring systematic study. What variables are critical (i.e., course design, teaching style,

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[8] Stevens (1986), however, describes some innovative electronic lectures 'E-lectures', which successfully reformulated the traditional lecture mode using the facilities of the electronic environment.

characteristics of the learner, class size, cc features, etc.) and how do these relate and impact upon the educational experience? Are there learners (or instructors) for whom this medium would not be appropriate or desirable? Is on-line learning in fact appropriate for all levels of education (schools, undergraduate education, continuing education)? Is it appropriate to all subject matter?

Further analysis of the perceived advantages and disadvantages to learning on-line is also important. The list presented here provides a starting point: there is a need to identify additional themes and issues; test and measure those identified to ascertain their relative weight and importance to students; and correlate these with other factors. Another important area is the study of how students organize themselves to learn on-line.

The data in this study indicates that for the students, the benefits of on-line education outweigh the problems, and that on-line courses can offer new forms of active and effective learning. The electronic medium holds significant potential for new forms of learning interactions and activities that are only beginning to be explored, and the challenge for educational researchers and practitioners is to discover how to make the most effective use of this exciting new learning environment.

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