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ABSTRACT

Computer-mediated communication (CMC) is one of the most recent technologies to be adopted for use in distance education. It provides the means to establish an electronic classroom that is accessible to participants separated by physical distance or time. The literature on CMC is as varied as are the many applications. Most CMC publications are either general descriptions of the medium or projections of new applications within educational and corporate institutions. This review, however, focuses on a small subset of publications with findings and recommendations derived from empirical studies about the use of CMC for distance education. Some findings from these studies are sufficiently robust that they suggest some general trends. While CMC is found to be an ideal medium for fostering discussion among distance students and enhancing participation rates, it is observed that a sufficient critical mass of students and a facilitative teaching style are essential to fostering and maintaining online dialog. Because success in a CMC course is dependent, in large part, on convenient access to a computer, institutions are exploring different ways to increase computer accessibility. (Contains 75 references.) (SLD)

A Review of Computer-Mediated Communication for Distance Education:

Teaching and Design Considerations

by Rosalie Wells

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A Review of Computer-Mediated Communication for Distance Education: Teaching and Design Considerations

Introduction

Computer-mediated communication (CMC) is one of the most recent technologies to be adopted for use in distance education. The first application of CMC for teaching has been variously given as a 1981 writing course offered by the Colorado Technical College (Feenberg 1989) and a 1982 course offered on The Source (Paulsen 1987). In January 1982, the Western Behavioral Sciences Institute (WBSI) became the first non-academic institution to offer an educational program through CMC (Feenberg 1987).

CMC is a means to establish an electronic classroom that is accessible to participants who may otherwise be separated by time zones and physical distance. Students and an instructor use their personal computers and modems to connect to a central host computer that is running a conferencing software program. Participants have 24 hour access to the host computer and can dial it up to receive or to leave messages for other participants. More than one person can be logged on at the same time (synchronous interaction) but typically the communication is asynchronous. A student can engage in individual communication with another student or the instructor, or participate in group projects with other distance students. For more information, see Harasim 1990; Mason 1989c; Mason and Kaye 1989; Wells 1991.

In a matter of only a few years, CMC has been implemented according to a wide range of educational models:

a. on an industrial level (1364 students in the Open University's (OU) course on Introduction to Information Technology, e.g. DT 200),
b. in bimodal institutions, e.g. the New Jersey Institute of Technology (NJIT) and the New York Institute of Technology
c. in established, new, or proposed graduate programs (Connected Education, Nova University; Boise State University; Athabasca University)
d. for distance teaching by self-selected teachers (e.g. the Ontario Institute for Studies in Education) (OISE);
e. as a communications adjunct for students in face-to-face classes (e.g. University of Guelph);
g. in projects linking individual classes from various countries, e.g. Intercultural Learning Network; National Geographic Kids Network

The literature on CMC is as distributed as these implementations. Material cited in this review was found in internal reports, conference proceedings, as well as in books and journals pertaining to education, psychology, technology, computers, and communication. Most CMC publications are either general descriptions of the medium or projections of new applications within educational and corporate institutions. In contrast, this review focuses on a smaller subset of publications whose findings and recommendations are derived from empirical studies regarding the use of CMC for distance education.

Designing a Course to Maximize the Potential of CMC

Course Content

One way to discuss the range of subject matter appropriate for a CMC classroom is to examine what courses have already been taught. While an exhaustive list is beyond the scope of this review, CMC courses have included:

Content Area	Institution	Source
Undergraduate		
foreign language labs	University of Arizona	(Smith 1990)
physics (special relativity)	Univ. of West Florida	(Smith 1988)
group performance skills	Pennsylvania State	(Phillips, Santoro, Kuehn 1988)
humanities; archaeology	Jutland Open University (Denmark)	(Lorentsen 1989b)
history	Rochester Institute of Technology	(Bissell, et al. 1987)
computer science	Open University	(Mason 1990)
	NKI (Norway)	(Paulsen 1989)
	NKS (Norway)	(Soby 1989)
	Dutch Open University	(Meurs & Bouhuijs 1989)
	Rochester Institute of Technology	(Bissell et al. 1987)
Graduate		
education	OISE	(Davie 1988; Harasim 1986)

engineer training; Army Research Institute (Hahn et al. 1991a)
leadership training

computer science
Nova University (Scigliano, Joslyn, and
(online Master's and Doctorates) Levin 1989)

Brisbane College of (Scriven, 1988)
Advanced Education
(Graduate Diploma)

Child and Youth Studies Nova University
(Doctorate)

Instructional and Boise State University
Performance Technology
(online Master's)

Media Studies Connected Education
(online Master's)

Distance Education Athabasca University
(online Master's; proposed)

This list suggests the wide range of subject areas at both the undergraduate and graduate level that has already being taught with this medium. New software developments in the areas of computer graphics and simulations and Digital Video Interactive (DVI) should further increase the range of courses that can be effectively taught with CMC. (See Alexander and Lincoln 1989; Van Duren 1989).

Group Work in CMC

In contrast to other forms of instructional technology, most of the interaction via CMC is asynchronous, that is, the students and instructor do not have to be interacting at the same time. It is this asynchronicity that enables CMC to support group work at a distance, one of the most significant potentials of this technology. (For an example of synchronous working groups, see Hahn et al. 1991a). For the purpose of this review, group work is defined as assigned collaboration among students for the purpose of producing either a joint or individual product.

However, there are few published case studies of actual group work supported at a distance using CMC, despite suggestions that this potential makes CMC unique among educational technologies (e.g. Harasim 1989; Kaye 1987). Available literature falls into two categories, intra-class and inter-class working groups. Intra-class collaboration includes small groups of students from the same class who are instructed to work together on an assignment. Most of the available literature on this type concerns case studies of graduate students at OISE. The main types of groups used at OISE include: plenary and small group seminars, online working groups of 5-8 students, learning partnerships, and team debates (Harasim, 1989). Learning partnerships composed of two students have proven valuable for socializing students to the medium and encouraging rapid acquisition of computer skills (Davie, 1988). Once students are accustomed to online communication, larger working groups of 5-8 students can be assigned to formulate an online presentation, which may then be critiqued by classmates (Davie, 1988; Harasim 1986).

Inter-class groups represent almost revolutionary forms of collaboration that could not readily be sustained by any other form of instructional technology. These groups engage in class-to-class communication across time zones, and often across cultures and continents. Examples of such projects include the Intercultural Learning Network (ICLN) (Levin, Kim, and Riel 1990), the National Geographic Kids Network (Newman, Goldman, Brienne, Jackson, and Magzamen 1989), the Rappi Project (Hart 1987), and Project Orillas (Sayers and Brown 1987). In these projects, students in one class use a computer, modem, communications software, and various combinations of networks to interact with students in classes that may be located across town or around the world.

These projects are remarkable for both the age of student participants and the range of projects. Students have ranged in age from elementary (Hart 1987) to middle, high school, and university levels (Levin, Riel, Miyake, and Cohen 1987). Such projects have demonstrated that students of all school ages can successfully engage in work supported by CMC, given sufficient teacher planning and an appropriate level of computer support.

These projects have also successfully expanded the range of subjects that have been successfully delivered via CMC. Cross-cultural collaboration has occurred across a wide spectrum of subject areas, including: social sciences (Butler and Jobe 1987), natural sciences (Levin, Rogers, Waugh, and Smith 1989; Levin and Cohen 1985), geography (Rogers, Andres, Jacks, and Clausen 1990), foreign language literacy (Cohen and Miyake 1986; Sayers and Brown 1987), as well as creative and technical writing (Owen 1989; Riel 1985).

The capacity of CMC to support group work at a distance may be one of CMC's greatest potential contributions to distance education. In addition, cross-cultural collaborations may even change the face of distance education. These interactions represent a fundamental synthesis of face-to-face and distance instruction, as classes collaborate on projects with their distant peers.

Participation Rates in CMC Classes

CMC has been used for instruction in various subjects and implemented according to a range of models. But regardless whether CMC has been used simply as a hotline for questions or as an electronic classroom, students' rate of usage is probably the most frequently cited datum in case studies. Participation rates, measured in terms of public and private messages, can vary as a function of various factors:

a. self-selection, i.e. do students have the option of taking a non-CMC version of the course (Kaye 1989);
b. the model of implementation, i.e. whether CMC is used as a communication adjunct to a face-to-face class, a hotline for questions, or an electronic classroom;
c. teacher expectations, indicated by basing a portion of the final grade on participation or by requiring a certain number of messages a week.

While participation is impacted by various factors, it may be helpful for comparison purposes to note some of the rates that have been reported.

1. In NKI's CMC course, The Computer as a Tool, 100 students produced a total number of 1246 written entries (Soby 1989). This total reflects the sum of comments made in the various conferences, 4 class sections of the course, and the online cafe. However, it is important to note that approximately 30 of the students were lurkers while 25 were "super active" (no numbers provided). (Lurkers are participants who read without making written contributions.) The remaining 45 students only logged on a few times.

2. In the nine month pilot course conducted by the Dutch Open University (DOu), the following participation rates were recorded for 53 students (Meurs and Bouhuijs 1989). Student-initiated messages included 288 sent to a tutor, 675 sent to other students (this number includes 486 exchanged between two students), and 74 sent to others.

3. Davie (1988) compared usage statistics for graduate education classes he taught in 1986 and 1987. There were 11 participants in the 1986 course and 15 in 1987. The mean number of participants logged on per week was 9.4 for 1987 and 14.3 for 1987. The mean number of notes entered per week in the main conference was 19.2 in 1986 and 18.1 in 1987. Of the notes entered in the main

conference, the mean number authored per student was 16.3 in 1986 and 11.8 in 1987.

In a 1989 CMC class on Program Evaluation, Davie instituted several changes, including requiring a specific number of logons per student. Over the course of the 13 week semester, 13 students produced 1950 notes (Davie, e-mail communication, November 1990).

4. The following figures pertain to two graduate education courses taught by Harasim (1989): One course with 38 participants generated 3,132 conference messages over 12 weeks, averaging 7 messages/person/week. Another graduate class with 29 participants generated 3,177 notes over 12 weeks, at an average rate of 9 notes/person/week.

5. In the University of Victoria's certificate course for managers and professionals, "Computing Tools for Management", 574 messages were logged between January 19 and April 22. The following distribution was reported (Muzio 1989): 24 students wrote 183 messages, the marker and instructor sent 344, and the course coordinators authored 44.

6. The Open University's DT 200 course was the first large-scale implementation of CMC with 1364 students and 65 tutors. More than 3000 messages were entered in the national 'forum' conference that was accessible to all participants. The combined 65 local conferences, each with a ratio of approximately 25 students to one tutor, generated over 4500 messages. Over 750 messages were entered in the closed conference for the 65 course tutors (Thomas 1989). (See Mason 1989a for a thorough examination of participation rates in this course.)

Various observations should be made concerning these participation rates. First, there is no reason to assume that the only students learning from the online interaction are the actual participants. Lurkers may be learners too. (Even face-to-face classes have their own form of lurkers, i.e. listeners but not speakers).

Second, specifying a mandatory number of logons may be one means to increase participation rates among certain groups of students. For example, students new to the medium may benefit from clear specification of performance levels (McCreary and Van Duren 1987). While requiring a certain level of participation may seem to mitigate the freedom of adult learners, online participation may be the only way an instructor can assess a student's online <u>attendance</u>. (In a face-to-face classroom, an instructor can see who's present, even though attendance does not necessarily guarantee attention.)

The performance rates cited here provide some paramaters for what a CMC discussion can look like. But as Mason (1989a) points out, what is almost uniformly missing is information about the actual content of these messages. Sheer quantity does not provide any information regarding the educational quality of the exchanges. This factor should receive greater attention in future studies.

Voluntary and Required Participation

Because CMC is relatively new, most attempts to implement it in educational settings have entailed adding it to already existing course materials. It has been adopted to: substitute for face-to-face tutorials, provide students with a faster turnaround time for instructor feedback, and give students access to their peers, either for informal dialog or for formal group assignments. These reasons constitute a continuum of usage ranging from strictly voluntary to the more mandatory usage that results when CMC is throughly integrated into the educational requirements of a course. While it is difficult to generalize findings across the implementation models cited earlier, results from various case studies indicate that the model chosen tends to impact usage rates.

Generally, voluntary usage is likely to result in low usage, whether the participants are students or tutors. For example, the OU examined tutors' voluntary usage of CMC for communication, mutual support and the exchange of information. The medium went largely unused, with tutors acknowledging that they would be motivated to use it only when required to do so (Mason 1987).

Similar results have been obtained with students at the OU (Mason 1987), the (DOu) (Meurs and Bouhuijs 1989), NKI (Paulsen 1989), and the U.S. Army Research Institute (ARI) (Hahn et al. 1991a). Students in the studies by the OU, the DOu, and NKI were all undergraduates, while participants in the ARI study were engineers working at the graduate level. In these cases where student-to-student interaction was encouraged but not required (either in the form of a mandatory number of messages per week or formal group work), strictly voluntary usage was considerably lower than course designers had anticipated.

Several factors can interact with voluntary usage, including the educational level of students, the time intensive nature of the medium itself, and the importance of a model to guide student participation. Educational level has been found to impact the amount of participation, with senior level and graduate students contributing at a more regular even intensive rate, compared to the more sporadic or read-only level of undergraduates (McCreary and Van Duren

1987). This finding does not suggest that CMC is inappropriate for less senior educational levels, only that additional care must be taken in designing these courses to insure sufficient student motivation.

A second factor that can interact with voluntary usage is the time intensive nature of CMC. Depending upon the software, participants can be subjected to lengthy logon procedures, time-consuming down-loading and printing of information, and sometimes even the rather tedious job of organizing this printed information into notebooks. Results from several evaluations suggest that course designers may tend to under-estimate these administrative tasks (Hahn et al. 1991a; Meurs and Bouhuijs 1989). For example, designers of the ARI CMC course expected students to spend a total of 8 hours per week on the course; results of a formative evaluation revealed that students were actually spending an average of 16 hours per week, with fully half that time devoted to administrative tasks related to the computer.

A third reason for the relationship between voluntary and low usage is that distance students at many universities may simply be unaccustomed to having convenient access to each other (convenient, that is, if hardware and software problems are minimal). Accordingly, students may need a model of collaborative distance education which shows them ways in which the benefits of peer interaction can justify the additional time demands of interaction. For example, an evaluation of the OU's DT 200 course showed that students attributed their propensity for lurking rather than writing to lack of time. However, Mason (1989b) concluded that the more fundamental reason was actually "the lack of a clear model on which to base their conception of how to participate" (p. 137).

In general, the more integral CMC is to a course, the more motivated students will be to use it because they simply cannot succeed in the course without doing so (Feenberg and Bellman 1990; Lorentsen 1989a). Ways to integrate CMC have included: requiring a mandatory number of logons per week or a minimum number of messages (Hahn et al. 1991a); insuring that important information (such as quiz questions/answers or instructor responses to questions) is only accessible through the computer; basing a certain percentage of the final grade on the content of the messages (McCreary and Van Duren 1987); assigning group work; and actually converting or rewriting paper-based correspondence materials for computer delivery (Hahn et al. 1991b).

There are various costs associated with requiring this level of participation. First, an institution is thereby obligated to provide user support and user friendly training in computer skills (Lorentsen 1989a). Second is the rather thorny issue of differential communication cost to students based upon their distance from the nearest dial-up node. Requiring a high level of participation can economically disadvantage those students who are most distant. (This factor had a major impact on the OU's decision to keep the CMC component in DT200 to a fairly minimal level) (Mason 1990).

Finally, at institutions where the cost-effectiveness of distance education is well-established, adding a CMC component without increasing tuition costs will require a fundamental rethinking of all the course components (Kaye 1989). In fact, the fullest exploitation of the potential of CMC for distance education may entail the conversion and redesign of course materials, a step taken by both the DOu (Meurs and Bouhuijs 1989) and ARI (Hahn et al. 1991a). (See Hahn et al. 1991b for a manual detailing conversion procedures for adapting correspondence materials for delivery through a CMC classroom.)

In conclusion, there are costs associated with exploring the potential of CMC, or including it as an option that remains largely under-utilized. The choice of which cost to pay lies with the institution.

Class Size

In face-to-face instruction where class discussion is a priority, it is important to find some balance between a group small enough to encourage initial comments and large enough to sustain an ongoing discussion. However, this same issue is even more prominant in CMC, because the "classroom" consists of comments that scroll by on a computer screen. An insufficient critical mass of "vocal" students can mean there are relatively few messages to read or respond to (Hiltz and Turoff 1978). For example, Manock (1984) noted a disappointing rate of participation in a CMC class of eight to ten students, while a larger class of over seventy participants generated many lively discussions and debates.

In establishing enrollment limits, it is important to note that the "real" class size is often much smaller in CMC than the enrollment figures would indicate. For example, research suggests that a minority of members (10%) can account for up to 50% of the messages. In fact, between 20%-25% of the students in a class can be lurkers, (Hiltz 1984).

The "real" class size may be further attentuated by asynchronicity. Because a CMC classroom is open to participants 24 hours a day seven days a week, it is possible that only a few, perhaps no, participants will actually be online making contributions at a given moment. However, increasing class size simply for the sake of critical mass can result in a class large enough to pose excessive time demands on instructors where other responsibilities are concerned, e.g. grading papers.

Twenty-five is a fairly recurrent number in the rather small number of reported case studies of CMC classes. Davie (1989) notes that he can teach about as many graduate students in a CMC class as face-to-face, about twenty-five. A Norwegian undergraduate CMC course had a main course conference of 100 students, 1 professor, and four tutors. However, there were four smaller "classes", each with 25 students (Soby 1989). A pilot course offered by the DOu used two tutors for 60 students (Meurs and Bouhuijs 1989).

In the first offering by the OU of DT200, all 1364 students had "read and write privileges" in the national conference, but only 25 or so students participated in each of the 65 tutor groups (Mason 1989b). As a result, the actual group size was more commensurate with that of a traditional class than the numbers first suggest.

An evaluation of this OU course revealed that the small tutor conferences sometimes lacked a critical mass of correspondents, while the number of messages in the national conference was often so overwhelming that it discouraged many students from participating. Several changes were then instituted: participation in the national conference became optional; tutor conferences focused on local matters and assignments; and a regional conference with approximately 300 students, one "super tutor", and 12 tutors became the primary forum for course discussion. These regional conferences had sufficient critical mass to be self-sustaining but not intimidating (Mason 1990).

An interpretation of these various reports of class size needs to consider a possible interaction with academic level, which has been found to impact participation rates (McCreary and Van Duren 1987). For example, Davie reported successful rates of participation in classes of approximately 25 graduate students, while the OU's DT200 course with tutor groups of 25 undergraduates frequently had low participation (Mason 1989a).

There are trade-offs to be made in setting the class size of a CMC course. As with face-to-face classes, institutions will seek to maintain high class numbers in order to maximize their return on professors' time. And it is important to have a sufficiently large class to insure a critical mass for discussion. A limited number of case studies suggests that approximately 25 students for a graduate or professional class may be large enough to sustain high rates of discussion; undergraduate classes, particularly with first-time users, may want to set higher enrollment limits.

Instructor Considerations in CMC Classes

Changes in Instructor Role

Leading a discussion in an educational computer conference can require an instructor to change teaching styles to function most effectively (Kaye 1989; Nipper 1989; Turoff 1990). In a CMC classroom, it may be appropriate for an instructor to pose questions instead of simply supplying answers, to learn when to remain silent, and to deflect an individual's requests for help to the group as a whole (thus encouraging student-to-student communication). One major consequence of a shift to more facilitative behavior is that the instructor monopolizes less class time. For example, in a face-to-face class, an instructor may monopolize 60-80% of verbal interaction (Dunkin and Biddle 1974; McDonald and Elias 1976), while a CMC instructor may only contribute 10-15% (Harasim 1987).

These changes in instructor role were illustrated in an early study which compared instructor and student behaviors during discussions in a CMC and a traditional classroom (Quinn et al. 1983). An evaluation disclosed that: the teacher in the CMC class directed half as many questions to students as the instructor in the face-to-face class; a comment by the CMC teacher was often followed by several student responses, compared to the almost 1:1 ratio characteristic of the traditional class; students in the CMC class evaluated each other's comments with greater frequency than students in the face-to-face class.

In a CMC class, it might not only be appropriate but necessary for an instructor to delay a response in order to allow students to respond to the issue and to each other. While this suggestion seems to contradict the importance of immediate feedback, it does highlight some of the complexities in CMC. While prompt feedback may generally increase student motivation and performance, it may subvert a computer conference by reducing it to glorified e-mail; too-frequent input by the instructor may reduce the responsibility students take for developing and preserving a true conference (Smith 1988).

Depending upon the specific course, a CMC class may place a more diverse set of responsibilities upon an instructor than a face-to-face class. This is not necessarily the case if CMC is used primarily for class discussion and group projects. But if various media like

CAI's are integrated into the coursework, the number of instructional responsibilities may multiply. One solution may be to have two instructors for a course. One can assume primary responsibility for course content and discussions, while the other focuses on training students on the software, user support services, and coordinating tasks (Harasim 1986; Phillips et al. 1988). (See Harbour et al. 1991 for an example of a training manual for CMC instructors).

Turnaround Time in Providing Feedback

CMC lies on a continuum of feedback, ranging from the immediacy of face-to-face dialogue to the three week turnaround time characteristic of many distance teaching institutions (Kaye 1989). While data are limited, certain case studies suggest that a turnaround time of 24 hours is a reasonable expectation for instructor feedback on assignments in a CMC course. Twenty-four hours was an expectation in the CMC courses conducted by the DOu and ARI (Meurs and Bouhuijs 1989; Hahn et al. 1991a). In the ARI CMC course, the full-time instructor provided feedback within 24 hours in 80% of the cases. In fact, most of the feedback occurred either within four hours or between 8-16 hours.

While 24 hours may be a reasonable turnaround time for a full-time instructor, there may be occasions in the course when even 24 hours is too slow. Students may need even prompter feedback in the case of gated material, i.e. required feedback from the instructor before the student can access other coursework. Otherwise, students may schedule a block of study time only to find themselves unable to proceed without instructor feedback (Hahn et al. 1991a).

In order to facilitate efficient progress through the course, instructors should consider: the use of prerequisites and gated material only when absolutely necessary; the utilization of self-check exercises whenever possible (Hahn et al. 1991b).

Computer-related Issues

Pacing

The same pacing techniques used in distance education can also be used in CMC, including assignment and course completion dates, media broadcasts, and postal mail. However, there are unique features of the CMC environment which have implications for pacing.

CMC is virtually the only medium capable of supporting group work at a distance. Group assignments are one way to pace distance students, because they must be on schedule in order to make contributions to their group (Hiltz 1986). The evaluation of the ARI CMC course showed that students tried very hard to stay on schedule in order to be prepared for group exercises; concern about letting other students down was highly motivating. Furthermore, the fact that group work unfolds over a period of days in a CMC class would seem to enhance its effectiveness in pacing (Hahn et al. 1991a).

A second pacing mechanism in a CMC class is gating, a capability in some conferencing software which allows students access to material only when the prerequisites have been completed. This capability not only helps preserve the sequence of materials envisioned by course designers, but also helps reduce information overload for the CMC novice. In fact, newcomers to CMC should have access to specific material only when ready (Vallee et al. 1975); thus, gating can not only preserve course integrity but can also serve as one way of pacing students.

A third pacing mechanism for CMC classes is to allow students computer access to certain activities for a limited period of time, a procedure which is also an unobtrusive method of encouraging frequent logons. For example, a professor at NJIT scheduled readings and discussion questions that could only be accessed on the computer from Monday through Wednesday of each week. During the second half of the week, students were to take an online quiz. These activities helped pace students by allowing them limited access to assignments and quizzes stored on the computer (Hiltz et al. 1990).

Computer-Training for Distance Students

One of the most persistent beliefs among CMC educators is that a successful class depends upon an organized face-to-face session prior to a period of computer communication only. Generally, the face-to-face meeting is designed to facilitate interpersonal interaction as well as the rapid acquisition of computer skills. While time to basic computer proficiency will vary as a function of the software, students, and course requirements, estimates have included 3-5 hours (Kaye 1987), 5-10 hours (Harasim 1986), and one week (no hours reported) (Mills 1987). Institutions which incorporate a face-to-face meeting prior to and sometimes during delivery of a CMC course include OISE, Nova University, the DOu, and WBSI.

However, it is important to emphasize that few if any studies have experimentally compared CMC courses delivered with and without a face-to-face component, so it is difficult to know whether a face-to-meeting is essential or merely desirable in certain contexts. Indeed, various organizations and institutions have successfully offered CMC courses that consisted exclusively of online interaction. These include courses offered by NKI (Paulsen 1987), ARI (Hahn et al. 1991a), Connected Education (Levinson 1989), the University of Victoria (Muzio 1989), and the OU (Mason 1990).

Because the rapid acquisition of computer skills is perhaps the primary reason for most face-to-face sessions, it is also important to note that there are ways to teach these skills at a distance. For example, in addition to print material, the OU developed an audio cassette designed to talk students through the various computer procedures required in the DT 200 course (Mason 1990). The OU also developed a front-end to CoSy that included an automatic logon, a simple menu, and a set of 'hand-held' tutorials (Mason 1990). Front-end logons were also developed by ARI (Hahn et al. 1991a) and NKS (Soby 1989).

In another case, the Canadian Medical Association and Telecom Canada used a synchronous audioteleconference and dataconference to train physicians at a distance in online retrieval systems (Marshall 1987). In the training session, the physicians logged on to iNet. At this point, the audio link allowed them to listen to the instructor discuss computer procedures, while the computer link (and entry of a special command) allowed them to simultaneously watch the contents of the instructor's computer screen appear on the monitor at each site.

Various institutions have demonstrated the feasibility of training basic computer conferencing skills at a distance. Because face-to-face meetings can place travel, time and financial constraints upon students, institutions should explore various techniques that would enable students to study not <u>only</u> the course content, but also the computer skills at a distance.

<u>Typing Ability and Successful Performance</u>

Because CMC is a text-based medium, it might seem that poor typists would be at a serious disadvantage. However, most studies of CMC <u>communication</u> conferences have found no relationship between typing ability and user acceptance (Kerr and Hiltz 1982). In one respect, good typists have a speed advantage, but differences between computer and typewriter keyboards can reduce transfer, thereby lessening the liability of inexperience (Vallee et al. 1975). Also, the asynchronous nature of the medium allows participants to work at a pace commensurate with their typing ability (Vallee et al. 1975).

However, some research by the Institute for the Future suggests that typing ability can affect performance in subtle, though not necessarily negative ways. Slower typists may be more selective in their responses, which is not necessarily a liability in a medium which can subject its participants to information overload. However, these differences in quantity do not address the quality of the responses made by experienced and inexperienced typists. Indeed, researchers at the Institute for the Future note that detailed performance data are not available (Vallee et al. 1975).

While no data indicate that poor typing ability has an adverse impact on performance, it would seem advisable for institutions to insure that typing tutorials are available upon request.

Convenient Access to a Computer

Convenient access to a computer is virtually a prerequisite for successful performance in a CMC course (Harasim 1986; Lorentsen 1989b; Hiltz 1990). In the many communication conferences conducted by the Institute for the Future, lack of convenient access to a computer was a major factor in non-starters and low usage by others (Vallee et al. 1974). Similarly, in a CMC study by Denmark's Jutland Open University, low usage was reported for students who had to use computers at local study centers, compared to other groups that had computers in their homes (Lorentsen 1989b).

Furthermore, this study found evidence of performance differences between students who have convenient access to computers at home or work, compared to those with access only at study centers. The former tended to learn the system more quickly and to set the agenda for discussion. In contrast, study center students often logged on for the first time only to find an overwhelming number of contributions to a discussion they had not had an opportunity to help define. As a result, they were more likely to merely read than to become active participants (Lorentsen 1989b).

Current Computer Accessibility

In a 1988 survey, the OU determined that one third of its students had access to a microcomputer, and that of this group, over 18% had access to one at home (Kirkwood 1988). The percentage of students with convenient access was even higher among students at the DOu. In 1987, a survey had shown that 56% of DOu students had access to a microcomputer (36% at home and 20% with access to one elsewhere); access was even higher among its science students, 81% of whom reported convenient access. However, modems were still comparatively rare among all groups of students (Meurs and Bouhuijs 1989). Similarly, a study by Australia's Brisbane College of Advanced Education showed that its students were more likely to have access to a microcomputer than to a modem; accordingly, the College rented modems to students in a pilot study (Scriven 1988).

However, the issue of convenient access is somewhat more complicated than it first appears. Quality of access, particularly in the home, is an important factor impacting successful performance in a CMC course (Kirkwood 1988). For example, performance can be affected if it is impossible to locate the computer in a quiet part of the home; if it must be assembled and disassembled for use; if there is no convenient access to a telephone for modem use; or if the computer disrupts other family members (Kirkwood 1988). In the CMC course implemented by the OU, surveys revealed that 2/3 of the 1364 students were able to leave their computer workstation permanently set up. However, a sizable 1/3 of the students were not (Mason 1989b).

A related problem is lack of access due to travel obligations associated with a job. In the ARI CMC study, students whose travel requirements cost them access to a computer found it difficult to make up the work (Hahn et al. 1991a). One way to minimize this problem is to supply students with or encourage them to purchase, portable computers. Portable computers have been supplied to students by both the University of Waterloo (Black et al. 1988) and ARI (Hahn et al. 1991a). Since portables are also sturdier, an institution which supplies computers to students should be able to minimize costs due to shipping damage as well as reducing the impact of hardware problems on students' performance.

Options for Insuring Computer Access

Since convenient access to a computer impacts successful performance, institutions offering CMC courses have several options. The first is to supply computers to students, a procedure adopted by ARI (Hahn et al. 1991a) and NJIT, which issues computers to all in-coming freshmen (Hiltz 1990). A second option is to place computers in local study centers (a procedure employed by Denmark's Jutland Open University) (Lorentsen 1989b). However, most institutions have chosen to require students to provide their own equipment. These include OISE, Connected Education, Nova, and the Electronic University. Prior to enrollment, 35% of the students at the Electronic University did not own a computer, but purchased one specifically to take courses (Osgood 1986).

Effective in 1988, the OU shifted responsibility for insuring computer access from the university to the students (Kirkwood 1989). At that time, the policy only affected a total of 11,000 students in five computing classes. Henceforth, these students have three options:

a. purchase an IBM or IBM-compatible from a specified vendor who has an agreement with the OU

b. rent a computer from the OU for the necessary time period

c. borrow a machine from the OU only for short periods of time and only in the event of hardware problems

It is worth noting that while requiring students to supply their own equipment may be the only way that institutions can offer CMC courses, the trade-off can be various problems associated with incompatible equipment (Heap 1990; Muzio 1989). These problems may be unavoidable, as an increasing number of people in industrialized nations acquire computers for various purposes, distance education among them.

Communication Via Text

In their first exposure to computer conferencing, most initiates may hesitate to contribute to discussions because of a fear of appearing unintelligent. While this concern exists in face-to-face discussions, the situation in a CMC classroom may be more threatening because the software preserves a complete transcript of class proceedings (Deutschman 1984). Part of the fear may be traced to a misperception by many students that leaving a note in a conference is publishing rather than speaking (Davie 1989).

This concern about public expression was evident in the pattern of interaction in a CMC course conducted by Harasim (1986). In the early stages of the course, students generated more personal messages than public conference items, a trend which reversed itself within 2-3 weeks. The anxiety about publishing disappeared as students became more comfortable with the medium. Assigning students to two-person learning partnerships can be an effective way to both encourage early responding and to socialize students to the medium (Harasim 1986).

Pedagogical Uses of a Computer Transcript

The presence of a permanent transcript is a feature that distinguishes CMC from classroom instruction as well as all other forms of educational technology. The transcript is a complete record of class proceedings that is automatically maintained by the conferencing software and which is available to all class members. Unfortunately, there is almost a complete dearth of published information regarding its educational and administrative value. Its potential value may lie in the following areas:

a. The permanancy of the transcript insures that an instructor's explanations offered to individual students will always be available for review at a later time. Indeed, the transcript reduces the likelihood that answers will have to be given repeatedly, for other students can always be referred to the transcript for elaboration (McCreary and Van Duren 1987).

b. By preserving the entirety of an instructor's explanation, the transcript is more complete than students' notes could ever be. As a result, the transcript provides students with a more complete and accurate basis for later reflection than class notes taken in haste.

c. The transcript can serve as the basis for evaluating individual and group performance. For example, a transcript is the only way to determine whether a student has met the requirement of a specified number of logons per week. But the transcript can also record the progress of small working groups and enable an instructor to assess the relative contributions of members for grading purposes. However, a transcript may be less helpful in large working groups, where the value of various contributions may be more difficult to determine (Harasim 1988).

d. A transcript can also be the basis of an assignment. Near the end of a class, students can print out the transcript and analyze it in a number of ways, including group dynamics, philosophical or ethical positions of the participants, and the evolution of individual's positions. While this procedure could offer exciting possibilities for synthesis and critique by students, there is only limited suggestion that it is being exploited by teachers.

Conclusions

Increasingly, computer-mediated communication is being utilized in distance education in implementations ranging from a hotline for student questions to an electronic classroom. Both graduate and undergraduate courses are now offered in a wide range of subject areas. Even some graduate degrees are offered <u>completely</u> through online instruction.

While published case studies are still a minority in the CMC literature, some findings are sufficiently robust they suggest general trends.

1. CMC is an ideal medium for fostering discussion among distance students, as evidenced by reports of hundreds of messages exchanged during courses. Participation rates may be impacted by various factors, including the educational level of students and the degree to which CMC is integrated into course requirements. Generally, participation rates are higher when success in a course is dependent upon use of CMC, rather than strictly voluntary.

2. A sufficient critical mass of students is essential to fostering and maintaining online dialogue. When establishing the class size for a CMC course, several factors must be considered. First, a percentage of students will be lurkers, i.e. readers rather than writers. Second, the asynchronicity of the medium means: that few if any students will be online at a given time and that discussions will unfold over days, even weeks. As a result, CMC class limits should be set slightly higher than those of a comparable face-to-face class.

3. A facilitative teaching style is essential in fostering an online discussion.

4. CMC enables an instructor to provide timely feedback to distance students, in many cases with a turnaround time of twenty-four hours.

5. While some institutions offer computer training to students at mandatory face-to-face meetings, a number of organizations are exploring ways to offer this training at a distance. Trends, such as more user friendly software and automatic logons, should facilitate the distance teaching not only of content content, but computer skills as well.

6. Success in a CMC course is dependent in large part, upon convenient access to a computer, either at home or work. Institutions are exploring various ways to increase computer accessibility: requiring students to purchase their own; renting computers to students; placing computers in study centers; and loaning computers to students for the duration of a class.

Because CMC is one of the newer technologies utilized in distance education, further research and evaluation is needed on all the issues highlighted in this review. In addition, certain trends can be noted which will impact all future users of CMC:

1. Some institutions are either modifying existing communication software for use in distance teaching or developing new software for that express purpose (Alexander and Lincoln 1989; Paulsen 1989; Van Duren 1989). These efforts should result in even more user-friendly software for use by distance students and instructors.

2. New developments like DVI and fax boards in computers should continue to transform the ways computers can serve distance students as course delivery systems.

3. While computer capabilities continue to expand an instructor's options for presenting course material, the course design implications of CMC have yet to be seriously addressed (Davie and Wells, in press). CMC presents unique challenges to designers, including: the asynchronicity of discussion; the possibilities for group work at a distance; and the presence of a permanent transcript of course proceedings. Such design implications must be addressed if CMC is to be fully exploited as an instructional technology for distance learning.

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